Spacelabs Medical
An OSI Systems Company

# 91369 Service Manual

**070-1156-00 Rev. A**

*more time to care*

**© 2004 Spacelabs Medical, Inc.**

*All rights reserved. Contents of this publication may not be reproduced in any form without the written permission of Spacelabs Medical. Products of Spacelabs Medical are covered by U.S. and foreign patents and/or pending patents. Printed in U.S.A. Specifications and price change privileges are reserved.*

*Spacelabs Medical considers itself responsible for the effects on safety, reliability and performance of the equipment only if:*

- *assembly operations, re-adjustments, modifications or repairs are carried out by persons authorized by Spacelabs Medical, and*
- *the electrical installation of the relevant room complies with the requirements of the standard in force, and*
- *the equipment is used in accordance with the operations manual.*

*Spacelabs Medical will make available, on request, such circuit diagrams, component part lists, descriptions, calibration instructions or other information which will assist appropriately qualified technical personnel to repair those parts of the equipment which are classified by Spacelabs Medical as field repairable.*

*Spacelabs Medical is committed to providing comprehensive customer support beginning with your initial inquiry through purchase, training, and service for the life of your Spacelabs Medical equipment.*

**CORPORATE OFFICES**

***U.S.A.***

*Spacelabs Medical*
*5150 220th Ave SE*
*Issaquah, WA 98029*
*Telephone: 425-657-7200*
*Telephone: 800-522-7025*
*Fax: 425-657-7212*

***Authorized EC Representative***
***UNITED KINGDOM***

*Spacelabs Limited*
*71 Great North Road, Hatfield*
*Herts AL9 5EN*
*Telephone: 44-1707-263-570*
*Fax: 44-1707-260-065*

*BirthNet, Data Shuttle, Flexport, Intesys Clinical Suite, Maternal Obstetrical Monitor, MOM, Mermaid, Multiview, PCIS, PCMS, PrintMaster, Quicknet, Sensorwatch, TRU-CAP, TRU-CUFF, TRU-LINK, UCW, Ultralite, Ultraview, Ultraview Clinical Messenger, Ultraview SL, Uni-Pouch, Universal Flexport, Varitrend and WinDNA are trademarks of Spacelabs Medical, Inc.*

*Other brands and product names are trademarks of their respective owners.*

**CAUTION:**

**Rx Only** **US Federal law restricts the devices documented herein to sale by, or on the order of, a physician.**

# Table of Contents

## Contents


### Introduction

Overview . . . 1-1
Physical Dimensions . . . 1-2
Electrical Specifications . . . 1-3
AC Line Requirements . . . 1-3
Environmental Requirements . . . 1-3
Regulatory Approvals . . . 1-3
Monitor Options . . . 1-4
Display . . . 1-4

### Setup

Unpacking the Monitor . . . 2-1
Assembling the Monitor . . . 2-2
Power and Battery Status . . . 2-2
Connections . . . 2-4
Rear Panel . . . 2-4
Side Panel . . . 2-5
Cabling . . . 2-6
Maximum Cable Lengths . . . 2-6
SDLC External Devices . . . 2-6
SDLC Bus Termination . . . 2-7
Alarm Relay . . . 2-7
Network Installation . . . 2-10
Ethernet Network Connection . . . 2-10
Ethernet Network Disconnection . . . 2-11
Power-ON Test . . . 2-11
External Devices . . . 2-11
Module Tests . . . 2-12
Configuring the Monitor . . . 2-12
Network Setup . . . 2-12
Serial Ports . . . 2-19
Monitor Calibration . . . 2-20
Change Biomed Password . . . 2-20
Clinical Menu . . . 2-21
Tone Configuration . . . 2-23
Edit Drug List . . . 2-25
Minimum Volume . . . 2-26
System Information . . . 2-26
Define Patient Identifier (PI) String . . . 2-28
Reset Monitor . . . 2-31

### Theory

Overview . . . 3-1
Major System Components . . . 3-1
Main Enclosure . . . 3-1
External Connectors . . . 3-2
External Controls . . . 3-4
Printed Circuit Board Assemblies (PCBAs) . . . 3-4
CPU PCBA . . . 3-4
Power Supply Section . . . 3-5

Core Processor Subsystem . . . 3-7
PCI Subsystem . . . 3-11
PCI/ISA Bridge . . . 3-13
Interconnect and Connector PCBAs . . . 3-14
Bezel Assembly . . . 3-15
Boot Sequence Overview . . . 3-17
Normal Operation Overview . . . 3-17
Main Subsystems and Tasks . . . 3-17
Display . . . 3-18
Parameter Modules . . . 3-19
CPU PCBA Connectors . . . 3-20
CPU PCBA Jumpers . . . 3-20
I/O PCBA Connectors . . . 3-21
Interconnect PCBA Connectors . . . 3-21

## Maintenance

Overview . . . 4-1
Required Test Equipment . . . 4-1
Mechanical Inspection . . . 4-2
Electrical Safety Testing . . . 4-2
Definitions . . . 4-2
Ground Resistance . . . 4-3
Chassis Leakage Current Tests . . . 4-3
Patient Lead Leakage Current Tests (Patient Modules) . . . 4-4
Preventive Maintenance . . . 4-4
Error Log . . . 4-4
Touchscreen Calibration . . . 4-5
Functional Tests . . . 4-5
Monitor Self-Test . . . 4-5
Monitor Functional Tests . . . 4-5
Assembly/Disassembly Procedures . . . 4-7
Required Tools and Parts . . . 4-7
Setup for Disassembly . . . 4-7
Installing or Replacing the Optional Recorder Assembly . . . 4-7
Inserting Recorder Paper . . . 4-10
Removing the Bezel Assembly . . . 4-10
Replacing the Display or Touchscreen Assembly, Backlight Inverter, and Power Monitor Assemblies . . . 4-12
Replacing the SDLC PCBA . . . 4-14
Replacing the CPU PCBA . . . 4-15
Removing the Chassis Assembly . . . 4-16
Replacing the Fan/Battery Contact Assembly . . . 4-17
Replacing the Interconnect PCBA and Frame . . . 4-18
Replacing/Aligning the Module Door . . . 4-18
Replacing the Embedded Nurse Alert Assembly . . . 4-18
Cleaning . . . 4-19

## Troubleshooting

Overview . . . 5-1
Required Tools and Parts . . . 5-2
Problem Solving . . . 5-2
System Startup . . . 5-2
Boot Menu . . . 5-3
Boot Parameters . . . 5-5
Power-ON Diagnostics . . . 5-5
Extended Diagnostics . . . 5-6

Diagnostic Menus . . . 5-7
Main Diagnostic Menu . . . 5-7
Individual Diagnostic Menu . . . 5-8
Error Log . . . 5-10
Displaying the Error Log . . . 5-10
Clearing the Error Log . . . 5-11
Diagnostics Failure Messages and Error Codes . . . 5-11
System Troubleshooting . . . 5-13
Required Tools/Test Equipment . . . 5-13
Display . . . 5-13
Monitor Fails Power-ON Diagnostics . . . 5-14
Touchscreen . . . 5-15
Module Slot . . . 5-15
SDLC Output . . . 5-15
Ethernet . . . 5-15
Alarm Relay . . . 5-16
External Display . . . 5-16
Keyboard, Mouse, or Barcode Scanner . . . 5-16
Battery . . . 5-16
Battery Charger . . . 5-17
Recorder . . . 5-17

**Parts**

Overview . . . 6-1
Parts List . . . 6-1
Field-Replaceable Parts . . . 6-1
Cables and Adapters . . . 6-3
Field-Replaceable Mounting Hardware Parts . . . 6-3
Miscellaneous Parts . . . 6-3
Assembly Drawings and Schematics . . . 6-4

**Directory of Keys**

BIOMED Directory of Keys . . . 7-1

**Glossary**

**Appendix A - Electromagnetic Compatibility**

Electromagnetic Emissions . . . 9-1
Electromagnetic Immunity . . . 9-1
Separation Distances . . . 9-3

**Symbols**

# Introduction

## Contents


Overview . . . . . 1
Physical Dimensions . . . . . 2
Electrical Specifications . . . . . 3
Environmental Requirements . . . . . 3
Regulatory Approvals . . . . . 3
Monitor Options . . . . . 4


## Overview

Spacelabs Medical's products are designed and manufactured under good manufacturing practices and in compliance with all applicable regulatory requirements. To ensure proper operation in accordance with these guidelines, this product must be maintained by trained technicians, using Spacelabs Medical authorized replacement parts.

Warnings, cautions, and notes are used throughout this manual. They are identified by the formats shown below. Be sure to read all warnings, cautions, and notes included in each section of this manual.

***Warning***

***Alerts the user to potentially serious outcomes (death, injury, or serious adverse events) to the patient or user.***

**Caution**

**Alerts the user to actions to be taken to avoid non-serious injury to the patient or user, or to adverse effects to the device.**

***Note:***

*Failure to observe notifications may result in unexpected outcomes.*

The 91369 monitor is a lightweight, portable monitor designed for use as a compact bedside monitor or as a battery-operated transport monitor. The monitor features a five-wire, resistive touchscreen and can be operated on either AC mains or battery power.

The single-high module slot on the right side of the monitor accepts all single-high modules, including the 90470 Multiparameter module, 90496 Ultraview® Command module, and 91496 Ultraview SL™ Command module, to permit the monitoring of parameters such as ECG, temperature, and invasive pressure.

*Figure 1-1: 91369 monitor*

# Physical Dimensions

| | |
|---|---|
| **Assembled Weight** | 10.0 pounds (4.6 kg) |
| **Dimensions** | 8.3 (H) x 11.7 (W) x 6.2 (D) inches<br>(21.1 x 29.7 x 15.8 cm) |

# Electrical Specifications

Designed for continuous operation. Requires outlet with ground (Protective Earth) conductor. Designated Class I by applicable electrical safety standards.

## AC Line Requirements

| | |
|---|---|
| **AC input voltage range** | 100 to 240 VAC |
| **AC input current** | 1.0 A |
| **AC input frequency range** | 50 - 60 Hz |

# Environmental Requirements

| | |
|---|---|
| **Operating Temperature** | 0° to 50° C |
| **Humidity (operating)** | 10% to 95% relative humidity, non-condensing |

# Regulatory Approvals

CSA certified. Meets IEC60601-1, UL60601-1, and CSA C22.2 No. 601.1 for electrical safety. CE marked in accordance with the Medical Device Directive 93/42/EEC.

# Monitor Options

The following options are available:

*Table 1: 91369 Monitor Options*

| Option | Definition |
|---|---|
| **N** | Vital Signs Calculations |
| **O** | Drug Dose Calculations |
| **Q** | Data Shuttle |
| **R** | Patient Data Logger (PDL) |
| **U** | Dual-channel internal recorder |
| **04** | Four waveform zones |
| **06** | Six waveform zones |

# Display

The video input of the display conforms with the Video Electronics Standards Association (VESA) display resolution of 1024 x 768 pixels. The monitor does not support an external touchscreen.

*Table 2:*

| | Vertical | Horizontal |
|---|---|---|
| Rate | 64 Hz | 51.584 Hz |
| Front porch | 58 µs | 0.350 µs |
| Sync width | 116 µs | 1.985 µs |
| Back porch | 562 µs | 2.101 µs |
| Blank | 737 µs | 4.435 µs |
| Video clock rate | 68.5 MHz | 51.584 KHz |

# Contents

Unpacking the Monitor . . . . . 1
Assembling the Monitor . . . . . 2
Connections . . . . . 4
Cabling . . . . . 6
Network Installation . . . . . 10
Power-ON Test . . . . . 11
Configuring the Monitor . . . . . 12

# Unpacking the Monitor

The 91369 monitor, one or two batteries, external AC power supply, and any optional accessories are all packaged and shipped in a single box. Keep at least one shipping box and its packing materials for re-shipping, if the monitor should ever require factory service.

**Caution**

**Observe precautions for handling electrostatic-sensitive devices!**

***Note:***

- *Never touch electrostatic-sensitive electronic components without following proper anti-static procedures, including the use of an ESD wrist band and mat. An electrostatic discharge from your fingers can permanently damage electronic components and cause latent failures.*
- *All static-sensitive electronic components are packaged in static-shielding bags. Retain the bag for repackaging the component should you need to store it or return it to Spacelabs Medical for any reason.*

The monitor is typically shipped as follows:

**Top Assembly** — Contains the main enclosure with installed CPU, power supply, and I/O PCBAs.

**Accessories** — Contains the external DC power supply, U.S. power cord, international power cords (if applicable), and any cable assemblies ordered.

**Before installing the monitor:**

***Note:***
*When removing items from the shipping containers, ensure that you remove ALL components from each container.*

1. Unpack the received equipment.
2. Unpack the mounting hardware.
3. Conduct an equipment audit.

Upon receiving the equipment, complete a detailed inventory to verify that the equipment you received matches your order. This inventory must include serial numbers, model numbers, and all options and cables received. Carefully inspect these items for shipping damage. If any damage is evident, immediately notify the freight company and Spacelabs Medical.

# Assembling the Monitor

## Power and Battery Status

The three LEDs on the monitor indicate whether the monitor is connected to the AC mains power and the status of any installed batteries. Battery status conditions are indicated as described in the following sections.

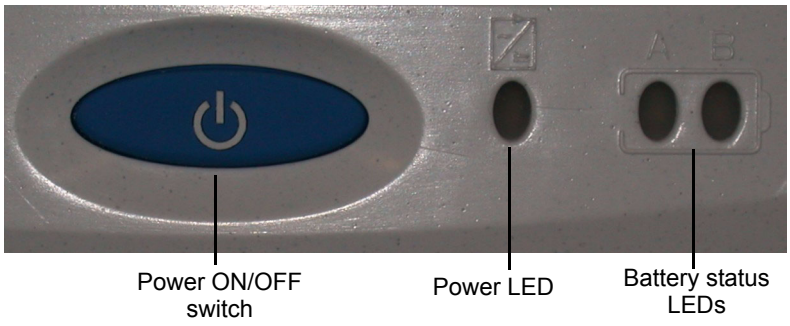



*Figure 2-1: Battery status information*

### Power LED

The power LED is located immediately to the right of the power ON/OFF switch. This LED is lit whenever the monitor is connected to AC mains power via its power supply, and is not lit if the monitor is not connected to the AC mains power.

### Battery Status LEDs

These LEDs are only active while the unit is connected to AC mains power.

#### *Unlit LED*

A battery LED that is neither solid ON nor flashing indicates a battery is not present.

#### *Solid Green LED*

A solid green battery LED indicates that the battery is fully charged. Only a charging cycle or a faulty battery will cause the green LED to flash, and these conditions only occur when a battery is installed in the monitor.

#### *Flashing Green LED — Battery Charging*

A flashing green battery LED indicates an installed battery is being charged and the monitor is not ready to be used in transport mode. This LED flashes in a constant pattern with no delays with the monitor powered ON or OFF. The flashing is different than the battery fault detection flash.

***Note:***

*The green LED stops flashing and stays ON when the charging cycle is complete.*

***Intermittent Flashing Green LED — Battery Fault Detected***

An intermittent flashing green LED indicates that this battery will not hold a charge, or is taking too long to charge. The intermittent signal is a repeating pattern of a solid green LED for one second and a flashing LED for one second. An error message is also added to the error log for review by your system administrator.

To determine whether a battery is faulty, power the monitor ON using the front-panel switch and observe the message displayed along the bottom of the monitor screen. Replace a faulty battery with the same battery type.

## Installing/Replacing Batteries

NiMH batteries are used in the monitor. Refer to *Figure 2-2* to install one or two batteries.

*Figure 2-2: Monitor battery installation*

While the monitor is operational, a single battery can be exchanged under any of the following conditions without a loss of patient data:

- The monitor is being powered by the external power supply.
- The monitor is operating on two batteries, and one charged battery remains connected at all times during the exchange.

***Warning***

***Batteries exposed to short circuit, high temperature, or fire may leak, vent, or explode.***

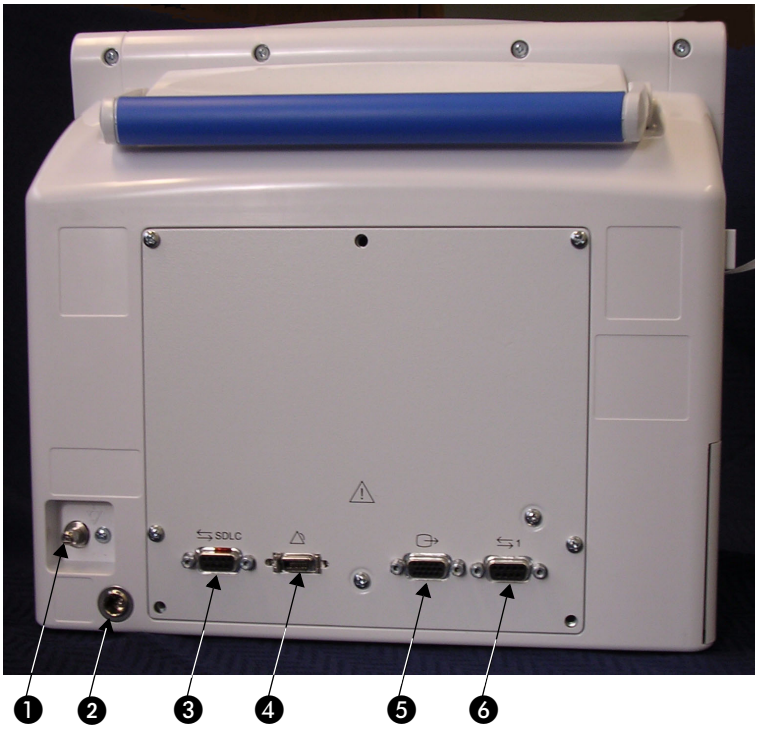
**Caution**

**Follow the manufacturer's recommended handling procedure. Collect and transport batteries in a manner that prevents short circuit, compacting, mutilation, or any other abuse that would compromise the physical integrity.**

# Connections

Refer to *Figure 2-3* for available connections on the monitor's rear panel. Refer to *Figure 2-4* for available connections on the monitor's side panel.

## Rear Panel




1. Equipotential ground post
2. External power supply input
3. SDLC port
4. Alarm relay output
5. Video output
6. Serial port

*Figure 2-3: Rear panel connections*

*Table 1: Rear Panel Cables*

| Rear Panel Connection | Description | Part Number |
|---|---|---|
| 6 | Cable, Serial I/O (RS-232) | As required |
| 5 | Cable, Video, DB15HD Male to DB15HD Male, 6 ft (1.8 m) | 012-0593-00 |
| 3 | Cable, SDLC | As required |
| 3 | Cable, Monitor to Module Housing, 2 ft (0.61 m) | 012-0532-02 |
| 3 | Cable, Monitor to Module Housing, 4 ft (1.22 m) | 012-0532-04 |
| 3 | Cable, Monitor to Module Housing, 8 ft (2.44 m) | 012-0532-08 |
| 3 | Cable, Monitor to Module Housing, 10 ft (3.05 m) | 012-0532-10 |

### Caution

**For continued electromagnetic interference (EMI) radiation compliance, use only cables that have been tested and approved by Spacelabs Medical. Refer to *Table 2* on page 6-3 for all cable part numbers.**

## Side Panel

7 USB ports

8 10/100BaseT network connection

*Figure 2-4: Side panel connections*

***Note:***

*The USB ports are to be used for Spacelabs-approved devices only.*

*Table 2: Side Panel Cables*

| Side Panel Connection | Description | Part Number |
|---|---|---|
| 8 | Cable, Ethernet, 10/100BaseT, 3 ft (0.94 m) | 175-0951-00 |
| 8 | Cable, Ethernet, 10/100BaseT, 6 ft (1.8 m) | 175-0951-01 |
| 8 | Cable, Ethernet, 10/100BaseT, 12 ft (3.7 m) | 175-0951-02 |
| 8 | Cable, Ethernet, 10/100BaseT, 20 ft (6.1 m) | 175-0951-03 |

# Cabling

## Maximum Cable Lengths

The following cables are limited to the indicated maximum length:

- **SDLC Cable** — 40 feet (12.2 m) maximum (total length from the monitor to the last device on the bus). For longer SDLC cable runs, contact a Spacelabs Medical Field Service Engineer.
- **Video Cable** — 100 feet (30.5 m) maximum (total length from the monitor to the last display).
- **Ethernet cable (10/100BaseT)** — 328 feet (100 m) maximum.

## SDLC External Devices

External devices (for example, Flexport interfaces) can be connected to the SDLC bus. (In this context, the term “external” means connected to the SDLC bus by cable via an external connector. This is in contrast to modules, which are connected by inserting them into a module housing.)

If no supplementary module housings are present (in addition to the module slot integral to the monitor itself), then external devices are connected directly to the SDLC connector of the monitor.

If one or more supplementary module housings are present, Flexport devices are connected to connector J2 on one of the supplementary module housings.

If multiple module housings are present, external devices must be connected to the *last* module housing in the daisy-chain; that is, the housing electrically farthest from the monitor on the SDLC bus. Even though multiple connectors may be available, only the SDLC connector on the most distal module housing can be used for connecting external devices. Do not use more than a single Flexport connector, regardless of how many module housings are present.

If multiple Flexport interfaces are to be installed, they must be daisy-chained using the T-cable supplied with those devices. Up to three Flexport interfaces may be connected in this way.

***Warning***

***Unreliable system operation will occur if the SDLC bus is not correctly terminated or the maximum cable length is exceeded. Flexport interfaces must be attached to the most distal module housing on the SDLC bus.***

### SDLC Cable Interconnection

To ensure electromagnetic interference (EMI) compliance, the appropriate Spacelabs Medical 9-pin connector must be used. Refer to the *Module Housings and Power Supplies Service Manual* (P/N 070-0680-xx).

## SDLC Bus Termination

The SDLC bus must be properly terminated for correct operation. If no external devices (for example, Flexports or multigas analyzers) are connected, proper termination of the SDLC bus is accomplished automatically. If external devices are connected, the switch on the module housing farthest from the monitor must be set to the terminated ( ) position. All others must be set to the non-terminated ( ) position. The SDLC clock and data signals are switched by the terminator switches and are not present “downstream” of any switch set to the  position.

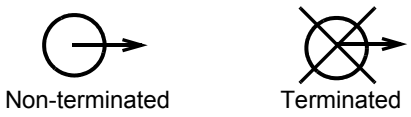



*Figure 2-5: Terminator switch settings*

Because bus termination is handled by setting the switches appropriately, an external terminator is only required when external devices are connected.

If external devices are connected, an external cable terminator is required to terminate the SDLC bus. This must be installed at the end of the SDLC bus (following the last external device). In this case, all module housings must have their switches in the  position.

***Note:***

*Flexports require a powered Flexport cable (P/N 012-0555-00) when used with the 90491/90499 module housing or 91369 monitor. SDLC data is only passed along to the external device(s) when the terminator switch (SW2) is in the  position.*

## Alarm Relay

Alarm output signals are available at the Nurse Alert ( ) connector instantaneously when an alarm occurs. *Table 3* describes the connector pinouts for remote alarms. *Figure 2-6*, *Figure 2-7*, and *Figure 2-8* illustrate the circuits for each alarm function.

### External Alarm Pinout

Alarm connector pinouts are as follows:

*Table 3: Connector Pinouts*

| Pin | Alarm Circuit | Meaning |
|---|---|---|
| 1 | Alarm 0 (high priority) | Common |
| 2 | | Normally Closed |
| 3 | | Normally Open |
| 4 | | GND |
| 5 | Alarm 1 (medium priority) | Normally Closed |
| 6 | | Normally Open |
| 7 | | Common |
| 8 | | GND |

*Table 3: Connector Pinouts (continued)*

| Pin | Alarm Circuit | Meaning |
|---|---|---|
| 9 | | +12 V, 140 mA |
| 10 | | GND |
| 11 | | GND |
| 12 | Alarm 2 (low priority) | Normally Open |
| 13 | | Common |
| 14 | | Normally Closed |

### *Warning*

***For operational safety and reliability, the following relay contact ratings MUST NOT BE EXCEEDED:***

- ***Current = 250 ma***
- ***Voltage = 28 V AC/DC***

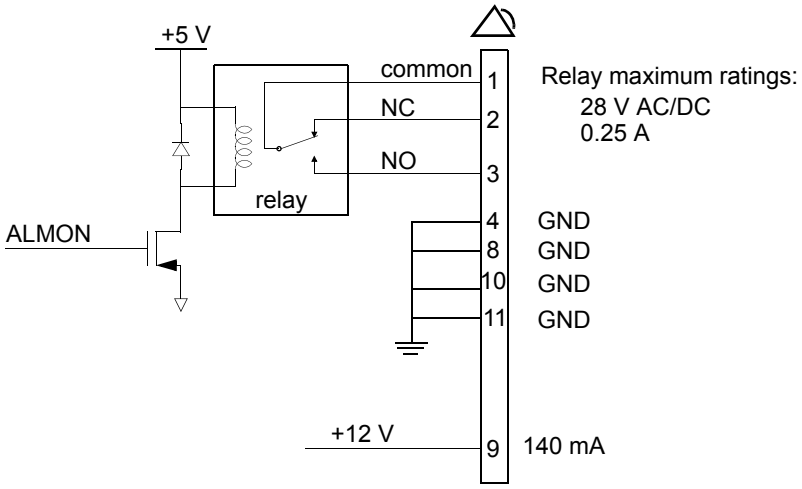



*Figure 2-6: Alarm 0 (high priority) relay schematic*

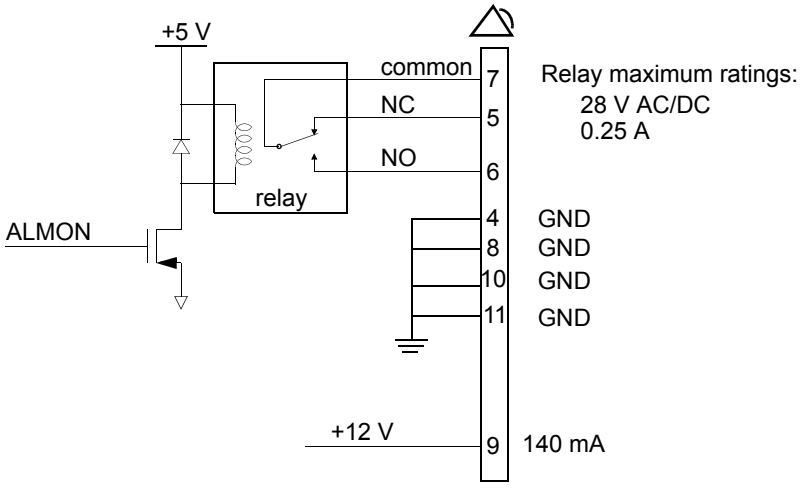



*Figure 2-7: Alarm 1 (medium priority) relay schematic*

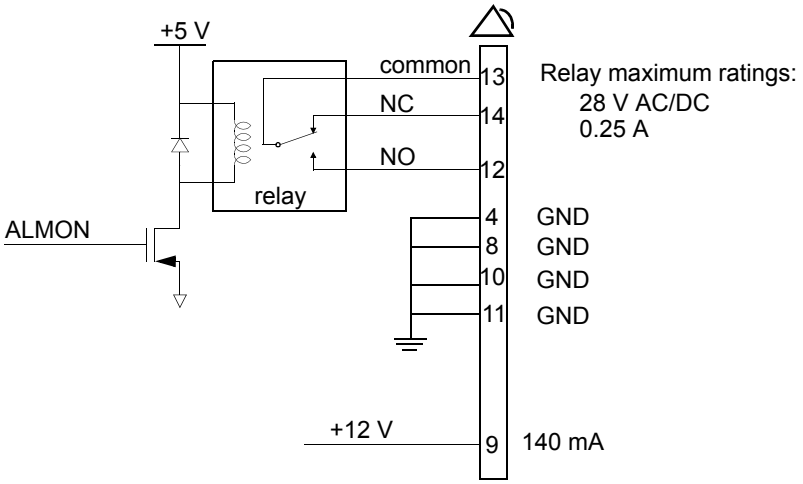



*Figure 2-8: Alarm 2 (low priority) relay schematic*

# Network Installation

A typical network consists of bedside and central monitors and an optional clinical information system (*Figure 2-9*).

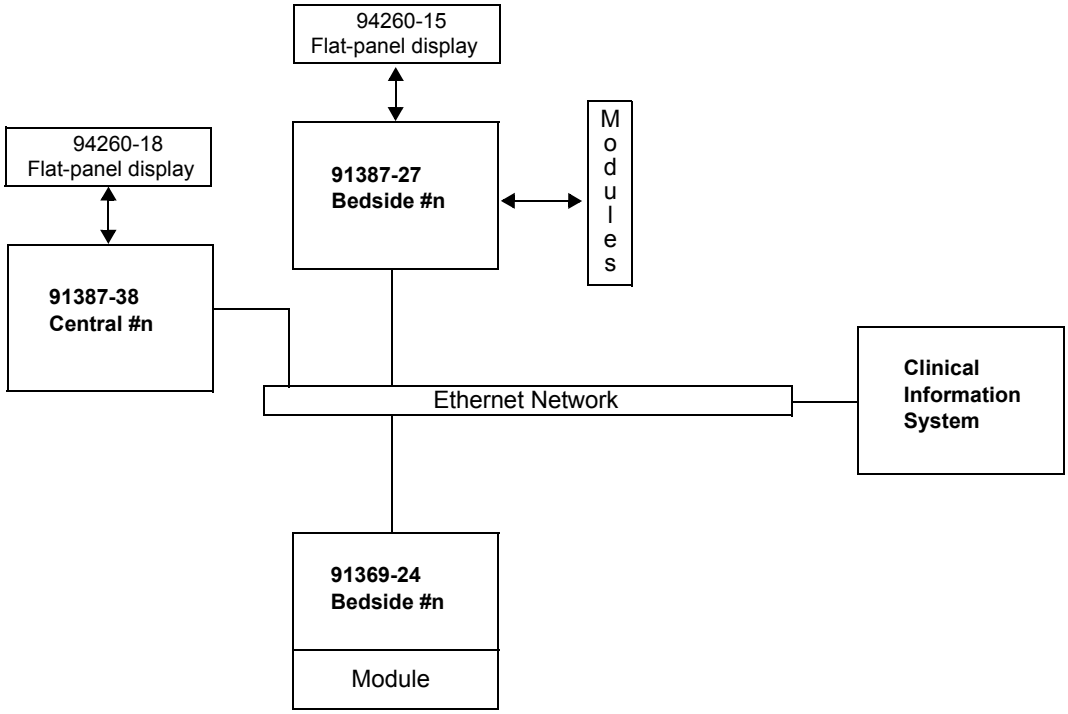



*Figure 2-9: Typical network configuration*

***Warning***

***Ensure that the Ethernet wall plate and the shield of the Ethernet connecting cable are bonded to the hospital grounding system.***

## Ethernet Network Connection

**Caution**

- **Only qualified personnel should attempt to connect a monitor to an Ethernet LAN the first time.**
- **Do not connect the monitor to an Ethernet LAN prior to configuring the following settings. The monitor must be properly configured for LAN access before you operate the monitor. If you fail to correctly configure the monitor, you may interrupt other units also using the LAN.**

***Note:***

*Detailed installation instructions for the physical Ethernet Local Area Network (LAN) are beyond the scope of this document.*

**To connect a monitor onto an existing Spacelabs Medical Ethernet LAN, complete the following steps:**

1. Install the monitor on a suitable table or shelf, ensuring that the air flow to the side air intake vents is unobstructed, or use a Spacelabs Medical mounting option.
2. Ensure that the monitor is not connected to the LAN.
3. Plug the power cord attached to the monitor's DC power supply into a standard hospital-grade AC power supply.
4. Turn ON the monitor.
5. Enter a unique MONITOR ID, BED NAME, and SUBNET for the monitor. Refer to *Network Setup* on page 2-12 for more information.
6. Attach the 10/100BaseT LAN transceiver cable into the RJ45 connector on the left side of the monitor (❽ in *Figure 2-4 on page 2-5*).
7. Connect the other end of the Ethernet cable from the monitor to the nearest port.
8. Configure the monitor's other network settings as necessary to ensure proper communication on the network. Refer to *Network Setup* on page 2-12.

### Ethernet Network Disconnection

To remove a monitor from the LAN, disconnect the network cable from the 10/100BaseT network connection (❽ in *Figure 2-4 on page 2-5*).

## Power-ON Test

Each time the monitor is powered ON:

- Diagnostic information displays for ~~approximately 10 seconds.~~
- The embedded alarm light cycles through red, yellow, and cyan.
- Monitor keys display on the right side of the screen.

The monitor is now ready for normal operation.

### External Devices

If an external SDLC device, such as a Flexport interface, is to be installed, the 9-pin SDLC connector on the rear of the monitor or the module housing must be used. If multiple SDLC ports on module housings are available, only the SDLC port on the module housing farthest from the monitor can be used for external devices. Set the termination switch to non-terminated (⊖) for all module housings and then terminate the external device.

## Module Tests

To verify that the monitor functions correctly with parameter modules:

1. Insert an ECG module without the patient cables connected. Verify that the ECG parameter key is displayed.
2. Connect a patient simulator to the ECG input with a 5-lead patient cable, and set the simulator to a known rate.
   - Verify that the heart rate and lead being monitored are displayed to the right of the ECG parameter key.
   - Verify that the ECG waveform is displayed.
3. Disconnect the patient cable. After 10 seconds, verify that the *LEADS OFF* message appears, the parameter key flashes yellow, and the medium priority alarm tone sounds.
4. Reconnect the patient cable and verify that the *LEADS OFF* message clears and the alarm stops.
5. Connect a patient simulator to the invasive pressure inputs.
6. Zero the pressures and verify that the numerics and waveforms are accurate.
7. Verify that the key tone sounds each time a key is selected.

# Configuring the Monitor

The **Biomed Level** menu displays when the biomed password (default is **biomed**) is entered into the **Privileged Access** window. Refer to *Directory of Keys* on page 7-1 for the **Biomed Level** menu structure.

## Network Setup

***Note:***
*The NETWORK SETUP key only displays on monitors that are configured for network operation.*

Touch NETWORK SETUP to display the **Monitor Setup - Network Configuration** window. This window contains an on-screen keyboard and three tabs: **TCP/IP**, **Monitor**, and **Printers**. Proper network operation requires that each device on the network have a unique network address, monitor ID, and monitor name.

### Editing Tab Fields

The fields within a tab on the **Monitor Setup - Network Configuration** window can be edited by selecting the field and entering new information using the on-screen or optional external keyboard.

When editing, adding, or deleting, press ENTER or TAB to cycle to the next input cell. Any changed or added items are stored in the monitor's non-volatile memory when SAVE is selected. The description of each tab indicates when that change takes effect (for example, immediately or after a monitor reset occurs).

**To edit text within a tab:**

1 Select an item from the list.
-OR-
2 Select an input cell's text and type any combination of letters, characters, or spaces.

**To add an item to a list:**

Select the input cell and type the new information.

**To delete an item from a list:**

1 Select the item.
2 Touch **Del**.
3 Enter at least one space (an error message is displayed if no spaces are entered).

## TCP/IP Tab

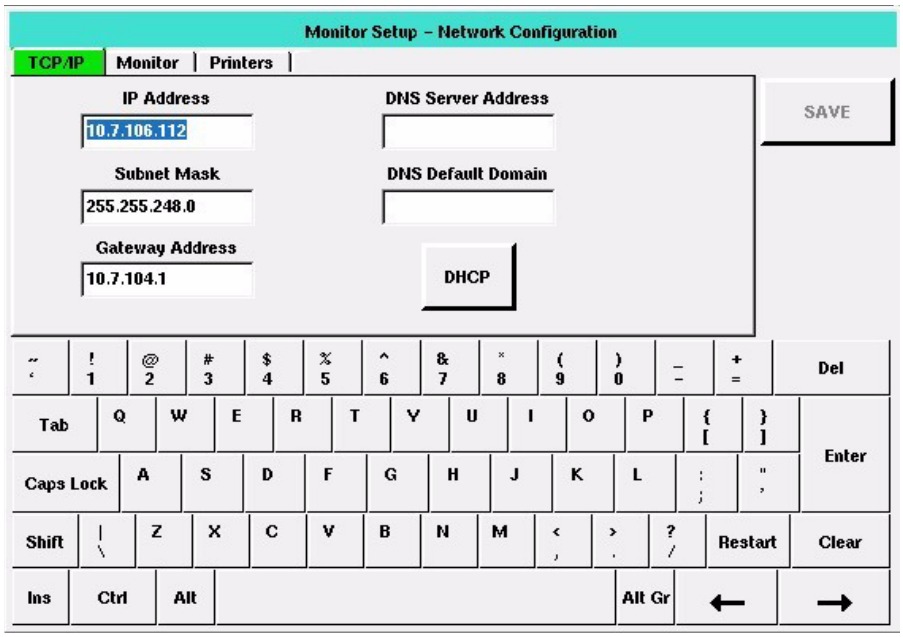



*Figure 2-10: TCP/IP tab*

The **TCP/IP** tab enables you to define the monitor's attributes for networking.

**IP Address** — Enables you to specify the monitor's IP address. The default is 164.90.254.10. Either a static IP address must be specified, or DHCP networking must be enabled.

**Subnet Mask** — Enables you to identify which parts of the IP address are to be used for TCP/IP subnet determination. The TCP/IP network's subnet mask is not related to the Spacelabs Medical network's subnet name. The standard and factory-default subnet mask is 255.255.255.0. Either a subnet mask must be specified, or DHCP networking must be enabled.

**Gateway Address** — Enables you to specify the IP address of the TCP/IP gateway (bridge or router) though which communication to other devices should flow. The default is blank.

**DHCP** — (Dynamic Host Configuration Protocol) Used to configure and enable DHCP network configuration. When DHCP is enabled, IP Address, Subnet Mask, and Gateway Address are automatically filled in. To use this service, a DHCP server must be available on the network to respond to DHCP requests.

***Note:***

- *A DHCP lease is a TCP/IP configuration given out from the DHCP server that is valid for a period defined by the DHCP server or forever (no expiration).*
- *Monitors configured for DHCP operation request a lease from the DHCP server when they boot up or when their existing lease expires during operation. If the DHCP server is not present, the monitor checks the expiration time of the last DHCP lease obtained. If the lease is still valid, the monitor continues to use those values and operates normally. If the lease has expired, the monitor disables TCP/IP networking and displays a NETWORK SIGNAL LOST message to indicate that it is unable to communicate over the network. The monitor continues to request a DHCP lease until it receives one.*
- *If the monitor's configured DECNET node ID is a duplicate on the network, the DHCP server can be confused. This may result in a duplicate or invalid DHCP lease and may prevent full network communication.*
- *The subnet mask must correctly correspond to the network size and type during operation. Monitors may not be able to fully communicate with each other if the DHCP server fails to set the network mask properly.*

The **DNS server address** is in standard TCP/IP address form, while the **DNS default domain** is a string of ASCII characters. A DHCP server may also provide this information.

Editing this tab is performed as described in *Editing Tab Fields* on page 2-12. Tabbing order is **IP Address** >> **Subnet Mask** >> **Gateway Address** >> **DHCP** >> **DNS Server Address** >> **DNS Default Domain** >> **IP Address**. Saved changes made within the tab take effect once the monitor is reset.

## Monitor Tab

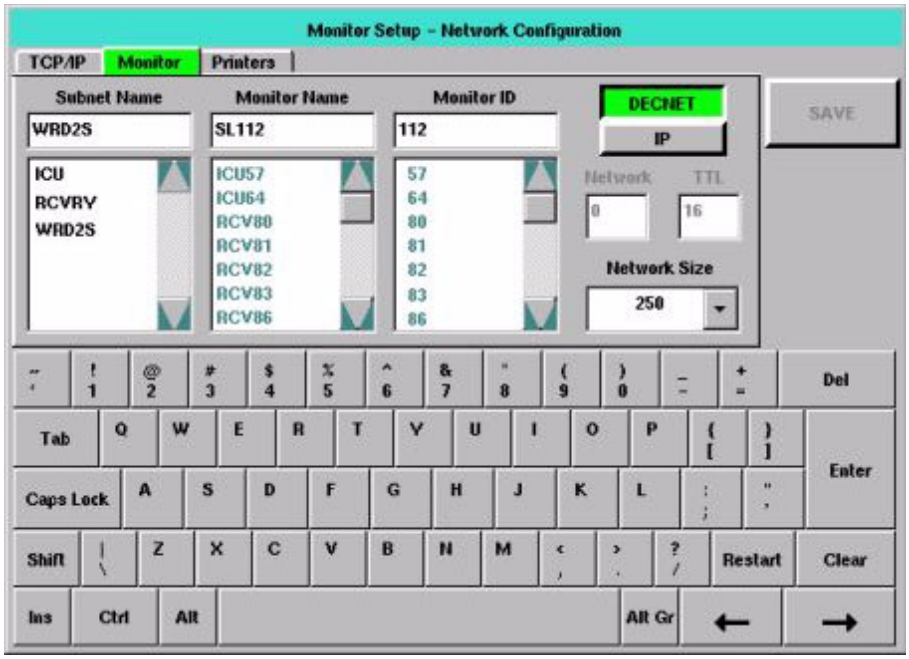



*Figure 2-11: Monitor tab*

The **Monitor** tab enables you to determine what monitor names, monitor (node) IDs, and subnet names are currently in use. The tab also enables you to enter settings for the monitoring network.

In *Figure 2-11*, the monitor's current settings are displayed in each input cell. The scroll list below each input cell displays the remaining items that have been detected on the network. Items in the **Subnet Name** and **Monitor Name** lists are displayed in alphanumeric order. Items in the **Monitor ID** list are displayed in numeric order.

Brackets (< >) surround strings that consist solely of spaces. The separation within the brackets indicates the number of spaces within that string.

Editing is performed as described in *Editing Tab Fields* on page 2-12. The tabbing order is **Subnet Name** >> **Monitor Name** >> **Monitor ID** >> **DECNET/IP** >> **Network** >> **TTL** >> **Subnet Name**. Network and TTL are skipped if disabled. Saved changes made within this tab do not take effect until the monitor is reset.

### *Subnet Name*

The subnet name contains up to five characters (default is five blanks). Items in this scroll list are selectable.

***Monitor Name and Monitor ID***

The Monitor Name is the name given to each bedside and central monitor (does not apply to telemetry bed names) to help the users identify monitors on the network. The Monitor Name contains five characters (default is **SL001**).

The Monitor ID is the numeric ID assigned to a monitor. Each device on the network must have a unique Monitor ID. This can be any number from 1 to 1023, depending on the Network Size selected.

To prevent duplication of currently used monitor names and IDs, items in these lists are not selectable. The error checking procedure performed when SAVE is selected also specifically checks for duplications.

***Note:***

*Items in these lists only display when the monitor is connected to the network.*

***DECNET/IP***

You can configure the monitor to operate using either Spacelabs DECNET or TCP/IP network protocols. If you are communicating with 903xx Spacelabs Medical monitors, you must select DECNET.

***Network***

The IP multicast group number of the monitor provides a filter to logically isolate one monitor from another on TCP/IP installations. Up to 32 network numbers are available (0 to 31) with 0 as the default.

***Note:***

*This is disabled if DECNET is selected.*

***TTL (Time to Live)***

The allowed number of hops the IP packet can take across network devices. TTL values are 1 to 64, with 16 as the default.

***Note:***

*TTL is disabled if DECNET is selected.*

***Network Size***

The network size allows configuration as:

**64** — Monitor IDs from 1 to 64 are supported. No more than 64 total monitor devices can be on the network. Provides complete network compatibility with legacy Spacelabs monitors.

**250** — Monitor IDs from 1 to 250 are supported.

***Note:***

*903xx monitors must have the Expanded Network option installed or they will not communicate correctly with devices with Monitor IDs above 64.*

**640** — Monitor IDs from 1 to 127 and from 512 to 1023 are supported with the following restrictions. All model 903xx Spacelabs Medical monitors must use monitor IDs 1 to 127, inclusive. All model 91xxx monitors must be configured with monitor IDs from 512 to 1023, inclusive.

**1000** — Monitor IDs from 1 to 1023 are supported (compatible only with Spacelabs Medical 91xxx series monitors).

## Printers Tab

The **Printers** tab enables you to display controls for defining and storing printer names, choosing rules for printer selection, and selecting one or two network printers.

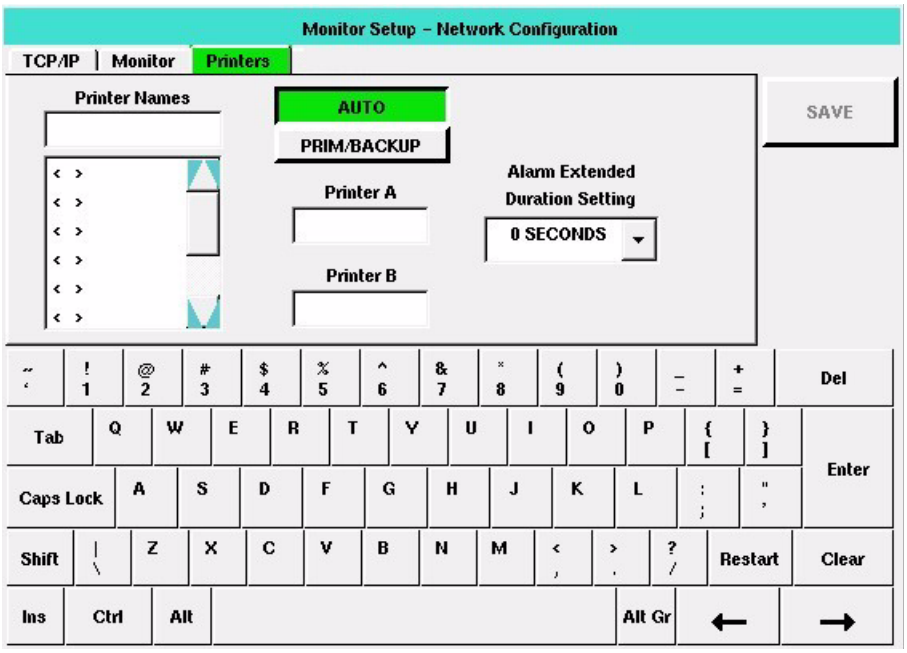



*Figure 2-12: Printers tab*

Editing is performed as described in *Editing Tab Fields* on page 2-12. The tabbing order is **AUTO** / **PRIM/BACKUP** >> **Printer A** (or **Primary**) >> **Printer B** (or **Backup**) >> **Printer Names** (refer to *Figure 2-13* on page 2-18). Changes made within this tab take effect as soon as they are saved.

### *Printer Names*

The **Printer Names** list displays up to eight, selectable printer names previously stored in this monitor, in the order in which they were stored. To display a new or changed name in the list, select that printer name from the list. Printer names contain up to five characters (default is five blanks).

***Note:***

- *Printer names are explicitly entered and may be duplicated. To clear a printer name from the list, select that name, touch **Clear**, touch **Enter**, and then touch **SAVE**.*
- *A local (SDLC) printer can be either a bedside printer or network printer, depending on the printer name selected in this list. A local printer is configured as a network printer if the local monitor's name is selected. Otherwise, a local printer functions as the bedside printer.*

### *AUTO / PRIM/BACKUP*

The AUTO / PRIM/BACKUP key selects which set of printer selection rules the monitor uses for selecting network printers. It does not affect the monitor's selection of whether a networked or non-networked printer is used. Any changes made to the printer selection mode using this key take effect immediately, regardless of monitor type. The default setting is AUTO, which selects the destination printer using the weight-based printer selection rules. (Refer to the *Ultraview SL Operations Manual, P/N 070-1150-xx, located on CD-ROM P/N 084-1101-xx for additional information*).

When PRIM/BACKUP is selected, the monitor automatically selects the primary printer, unless that printer is unable to accept the recording. In that instance, the monitor then selects the backup printer. If the backup printer is also unable to accept the recording, the monitor displays an **Unable to record** message.

## Printer Selection Fields

The default for the printer selection fields is blank (i.e., no printer selected). The labels above these fields vary, based on the current setting of the AUTO / PRIM/BACKUP key. If AUTO is selected, the labels are **Printer A** and **Printer B**. If PRIM/BACKUP is selected, the labels are **Primary** and **Backup** (*Figure 2-13*).

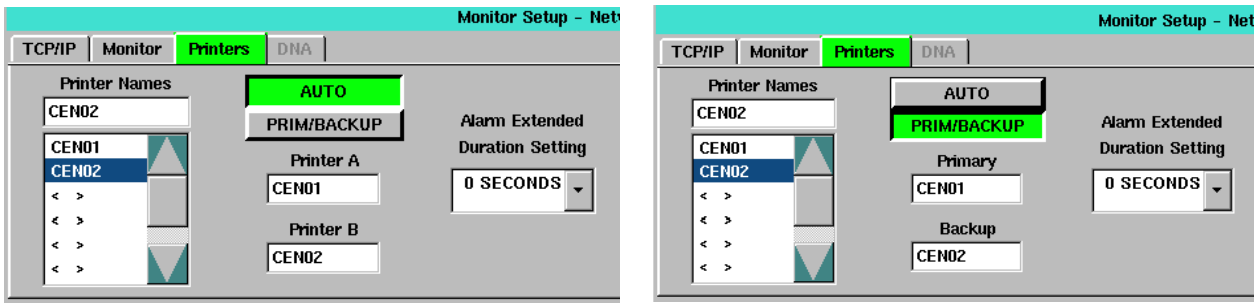



*Figure 2-13: AUTO / PRIM/BACKUP selection differences*

**To define a printer name:**

1 Select a printer name from the **Printer Names** list.

2 Select one of the two printer selection fields. The new value displays in the selected field.

### Extended Alarm Recording Duration

Selecting the **Extended Alarm Recording Duration** list enables you to add **0 Seconds** (default), **6 Seconds**, or **12 Seconds** to each alarm recording.

When **0 Seconds** is selected, alarm recordings end as defined by the alarming parameter when the alarm event ends. The other two selections extend any alarm recording by 6 or 12 seconds, enabling the offset of long-duration events to be printed.

***Note:***

- *Alarm recordings persist for the duration of the event as defined by the parameter that initiated the alarm recording. Alarm recordings for long duration events (for example, apnea, asystole, ventricular fibrillation, and ventricular tachycardia) may end before the offset of these long-duration events are printed.*
- *The extended alarm recording duration applies to ALL alarms from all parameters.*

## Serial Ports

Refer to *Directory of Keys* on page 7-1 for the menu structure.

### Patient Data Logger (Option R)

The Patient Data Logger option automatically sends patient vital signs from the monitor to a serial external device, such as a printer or a terminal. Episodic patient data is also sampled and transmitted. The output is in the form of ASCII text byte strings and is printed using standard RS-232 serial communications via the monitor's serial port (refer to the *Ultraview SL Operations Manual*, P/N 070-1150-xx, located on CD-ROM P/N 084-1101-xx for configuration information).

This option continues to send data whether the external device is on-line or off-line. Data transmission can be stopped by reassigning the data port or disabling the Patient Data Logger option.

Communication between the monitor and the external device is set up by assigning the serial port to Patient Data Logger and then adjusting the serial port settings. The various serial settings can be adjusted to suit the device attached to the serial port.

**To set up Patient Data Logger:**

1 Touch MONITOR SETUP.

2 Touch PRIVILEGED ACCESS.

3 Enter the biomed password (default is **biomed**).

4 Touch SERIAL PORTS and select **1**.

5 Touch ASSIGNMENT.

6 Touch DATA LOGGER.

7 Touch PREVIOUS MENU.

**To set serial settings:**

1 Touch SETTINGS.

2 Touch the desired setting key(s) to display and set the desired settings.

3 Touch NORMAL SCREEN to effect changes.

## Monitor Calibration

The MONITOR CALIBRATION key in the **Biomed Level** menu allows you to perform a touchscreen calibration in the event the touchscreen becomes difficult to use or a replacement has been installed. Refer to *Touchscreen Calibration* on page 4-5 for instructions on performing this calibration.

## Change Biomed Password

The CHANGE BIOMED PASSWORD key in the **Biomed Level** menu enables you to change the password used to access the **Biomed Level** menu.

**To change the biomed password:**

1 Enter the current biomed password in the **Password** field using the on-screen keyboard (passwords are not case-sensitive).

2 Enter the new biomed password in the **New Password** field and enter the same password again in the **Verify Password** field using the on-screen keyboard.

***Note:***

*If the biomed password is forgotten, contact your Spacelabs Medical Field Service Engineer.*

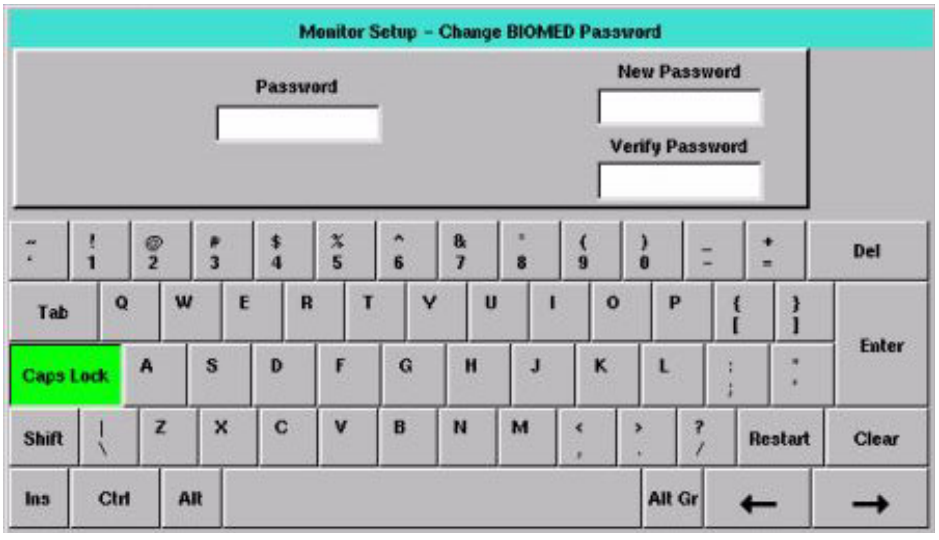



*Figure 2-14: Change BIOMED Password dialog box*

# Clinical Menu

The CLINICAL MENU key in the **Biomed Level** menu provides access to several features described in the sections that follow. Refer to *Directory of Keys* on page 7-1 for the menu structure.

## Time/Date

The TIME/DATE key accesses the **Monitor Setup - Time/Date** menu. The current time or date displays above the menu. The time displays in either a 12- or 24-hour format. Network monitors display the network time; standalone monitors display the internal system time.

- TIME/DATE — Select TIME or DATE, use the arrow keys to set the correct time or date, and touch ENTER.
- 24 HOURS — Displays the time in a 24-hour format. Touch ENTER to complete the selection.
- AM/PM — Select AM or PM to display the time in a 12-hour format, and then touch ENTER.

***Note:***
*Setting the time on any networked monitor sets the time for all monitors on that network.*

## Preselected Recordings

Refer to the *Printing* chapter in the *Ultraview SL Operations Manual* (P/N 070-1150-xx), located on CD-ROM P/N 084-1101-xx, for information regarding preselected recordings.

## Units of Measurement

The UNITS OF MEASURE key provides access to the units of measurement that the monitor uses for input, display, and printing of values for pressure, height, and weight measurements. Each key's label indicates the available selections. Reset the monitor after making changes in this menu.

## User Access

The USER ACCESS key allows the system administrator to preset certain functions and features of the monitor for availability to non-privileged-access users.

- PATIENT TYPE / ON/OFF — Enables (ON) or disables (OFF) the "Patient Type" selection in the **Admit/Discharge** dialog box.
- PARAMETER CONFIG / ON/OFF (bedside monitors only) — Displays (ON) or removes (OFF) the PARAMETER CONFIG key in the **Monitor Config** menu.
- RECORDING DURATION / ON/OFF — Displays (ON) or removes (OFF) the RECORDING DURATION key in the **Recorder Config** menu.
- SUBNET ACCESS / ON/OFF — Select ON to display keys for other care areas (subnets) within bed selection windows for features such as Alarm Watch, Remote View, Screen Format, etc.
- DEFAULT ENG. SAV MODE / ON/OFF — Turns the monitor's power-on, default-energy-saving, power mode ON or OFF and changes the setting of the ENERGY SAVING MODE / ON/OFF key that appears when the monitor is operating on battery power.

### Alarm Setup

Touch the ALARM SETUP key to display the following keys:

- REMOTE ACCESS / ON/OFF — Select ON to allow alarm limits from this monitor's parameters to be changed remotely (from central monitors or from bedside monitors via Remote View).

  Selecting OFF ensures that alarm limits for this monitor's parameters can only be changed at this monitor.
- ALARM SUSPEND / ON/OFF — Select ON to enable access to the TONE RESET/ALM SUSPEND key's Alarm Suspend function.
- TREND SUSPEND / ON/OFF — Select ON to allow trending to occur when all alarms are suspended via the ALARM SUSPEND key.
- ALARM RELAY — Allows characteristics of the monitor's external alarm relay to be defined. When an alarm occurs, this relay can activate an external device to identify which monitor is in alarm. In general terms, monitors activate their alarm relay whenever an alarm is occurring on that monitor.
  - RELAY TIMEOUT / 0 SEC/10 SEC — Select 0 SEC to deactivate the alarm relay when the alarm ends. Select 10 SEC to deactivate the alarm relay 10 seconds after the alarm ends.
  - ALARM LEVEL — The alarm relay can be activated for all alarms or for alarms at or above the selected priority only. Selections of HIGH, MEDIUM, and LOW are available. For example, selecting MEDIUM results in activation of the alarm relay for HIGH and MEDIUM priority alarms, but not for LOW priority alarms.
- QRS/SPO2 TONE ENABLE / ALWAYS/DURING ALARM — Controls whether the monitor sounds the QRS or $SpO_2$ tone all the time (ALWAYS) or only during alarm conditions (DURING ALARM). The QRS or $SpO_2$ tone must also be enabled using the controls within those parameters' menus.

### Alarm Watch Setup

The ALARM WATCH SETUP key controls how this monitor responds to alarm watch messages received from other monitors.

- ROTATE ALARM WATCH / ON/OFF — This key enables (ON) and disables (OFF) the alarm watch rotation feature (default is OFF).
- ALARM WATCH ROTATION / PRIORITY/SIMPLE — When a monitor receives more than one alarm watch message at a time, it uses a "first-in, first-out" rotation scheme to display the alarming parameters. This key is only enabled when ROTATE ALARM WATCH is set to ON. The following choices of rotation schemes are available:
  - SIMPLE rotation cycles through the alarming parameters in the order they go into alarm (first come, first served).
  - PRIORITY rotation cycles through the alarming parameters based on each parameter's alarm priority (for example, parameters with high-priority alarms display before parameters with medium- or low-priority alarms).
- ROTATION TIME / 15 SEC/30 SEC — You can choose to display an alarm watch for either 15 or 30 seconds before cycling to the next alarm watch if there are two or more alarm-watched beds in alarm. This key is only enabled when ROTATE ALARM WATCH is set to ON.

### Change Clinical Password

The CHANGE CLINICAL PASSWORD key enables you to change the password used to access the **Clinical Level** menu.

**To change the clinical password:**

1. Enter the current clinical password in the **Password** field using the on-screen keyboard (passwords are not case-sensitive).
2. Enter the new clinical password in the **New Password** field and enter the same password again in the **Verify Password** field using the on-screen keyboard.

***Note:***
*If the clinical password is forgotten, contact your system administrator.*

### Reset Monitor

The RESET MONITOR key allows you to reboot the monitor after changing settings for the following items (the monitor must be rebooted before these changes can take effect):

- Subnet access
- Units of measurement

Touching the RESET MONITOR key displays the **Reset Monitor** dialog box. Select **Reset Monitor** to proceed or **Cancel Reset** to cancel.

***Note:***
*Patient data are preserved when the monitor is restarted using the RESET MONITOR key.*

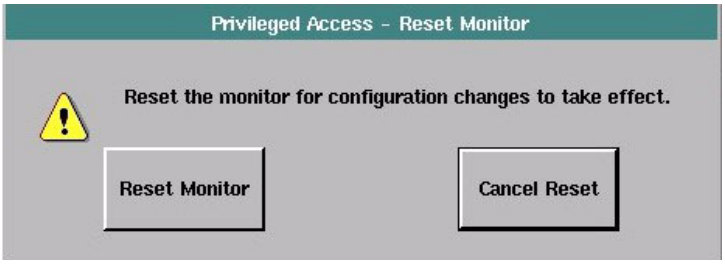

Privileged Access - Reset Monitor
Reset the monitor for configuration changes to take effect.
Reset Monitor
Cancel Reset

*Figure 2-15: Privileged Access - Reset Monitor dialog box*

## Tone Configuration

The TONE CONFIGURATION key in the **Biomed Level** menu enables you to configure the monitor's alarm tone configuration. Refer to *Directory of Keys* on page 7-1 for the menu structure.

### ISO Standard Alarm Tones

The ISO STANDARD ALARM TONES key enables you to configure the monitor for ISO (International Standards Organization) standard alarm tones and reset the values displayed in the alarm period keys, within the **Configurable Alarm Tones** menu, back to default settings.

### Configurable Alarm Tones

The CONFIGURABLE ALARM TONES key enables you to configure the monitor for ISO standard alarm tones with a configurable repetition rate.

- HIGH, MEDIUM, LOW — The values displayed on the lower lines of the HIGH, MEDIUM, and LOW keys are the current settings (within that key's adjustment range) for the repetition rate for that alarm's priority.

*Table 4: Alarm Period Default Values*

| Selected Alarm Period Key | Adjustment Range (and Default Value) | Enables Arrow Keys and Deselects |
|---|---|---|
| HIGH | 0 to 30 seconds (15 seconds) | MEDIUM and LOW |
| MEDIUM | 0 to 45 seconds (30 seconds) | HIGH and LOW |
| LOW | 0 to 45 seconds (30 seconds) | HIGH and MEDIUM |

- ↑ and ↓ — The up and down arrow keys are enabled when one of the alarm period keys is selected. The arrow keys are used to adjust the repetition rate for the selected alarm priority in five-second increments within that priority's adjustment range.
- FACTORY DEFAULTS — This key deselects all the period keys, resets their values to the ISO standard values, and disables the arrow keys.

### Continuous Alarm Tones

The CONTINUOUS ALARM TONES key enables you to configure the monitor for continuous alarm tones. This has no affect on the alarm period keys in the **Tone Configuration** menu.

### Alarm Tone Access

The TONE ACCESS / ON/OFF key enables you to configure the monitor for user alarm tone access. The TONE / ON/OFF key in the **Alarm Tone**, **Remote Alarm**, and **Alarm Watch Tone** menus is not displayed if OFF is selected. This has no affect on the alarm period keys in the **Tone Configuration** menu.

## Edit Drug List

The EDIT DRUG LIST key in the **Biomed Level** menu enables you to input and edit the master drug list from any monitor. The master drug list can then be received by any monitor and stored in that monitor's non-volatile memory. The master drug list can store up to 16 drug names and associated data.

Prior to initially storing the drug list in a monitor (either via direct input or transfer), all monitors have blank drug list names and display defaults that correspond to the standard drugs A through D (refer to *Table 5*). This set of four default values is repeated for every fourth item in the drug list (for example, default settings for the 5th and 9th drugs in the list are identical to the settings for Drug A, the 1st drug in the list).

*Table 5: Standard Drug Values*

| Key | Neonatal Drug | Adult Drug |
|---|---|---|
| A | Dopamine or Dobutamine | Dopamine or Dobutamine |
| B | Isoproterenol | Lidocaine, Pronestyl or Bretylium |
| C | Tolazoline | Nitroglycerine or Levophed |
| D | Nitroprusside | Nitroprusside |

Touch EDIT DRUG LIST to display the **Drug List Selection Menu** (*Figure 2-16*). Selecting any drug name from this list highlights that line. The drug list may be blank (if all the entries are blank) or display one or more blank lines.

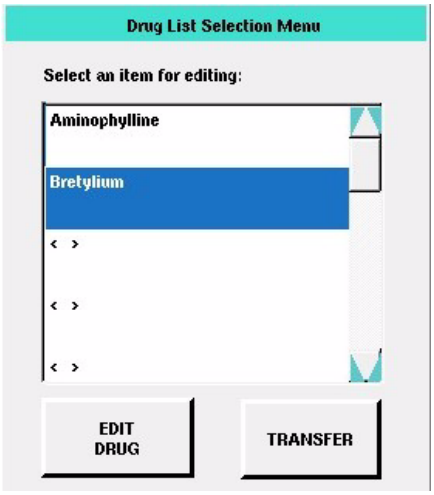



*Figure 2-16: Drug List Selection Menu*

***Note:***

*To remove a drug from this list, you must overwrite the entry with blanks.*

Touch EDIT DRUG to display the **Edit Drug** dialog box (*Figure 2-17*). Enter information in the fields using the on-screen keyboard. Touch SAVE to save the data to the drug list.

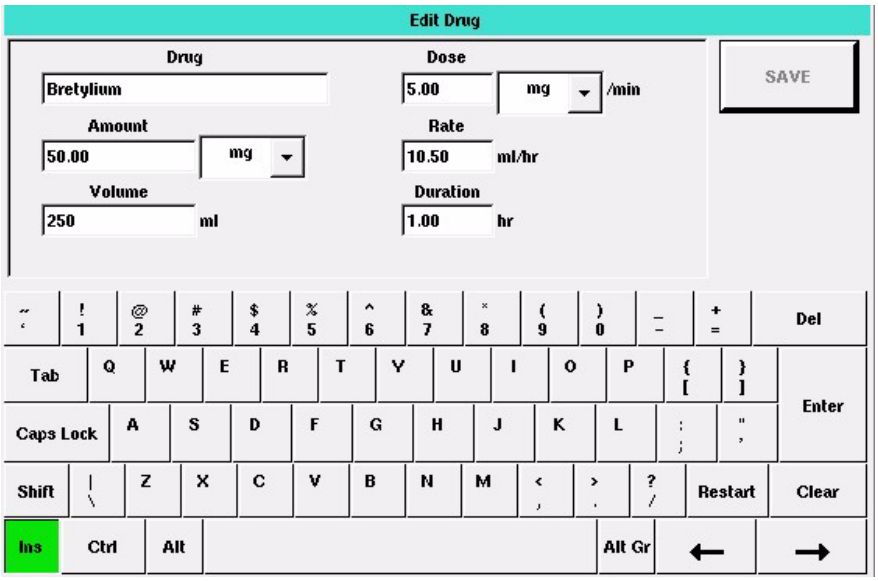



*Figure 2-17: Edit Drug dialog box*

Refer to the *Ultraview SL Operations Manual* (P/N 070-1150-xx) located on CD-ROM P/N 084-1101-xx for additional information.

## Minimum Volume

The MINIMUM VOLUME / ON/OFF key the **Biomed Level** menu locks (ON) the current alarm tone volume setting as the minimum alarm tone volume. Verify the volume setting before selecting ON.

## System Information

The SYSTEM INFO key in the **Biomed Level** menu accesses the monitor's **System Information - Digital** screen (actual data may differ from the example in *Figure 2-18*).

PCBA Information
CPU board P/N : 670-1275-00 S/N : 00000A225608
Wireless : None
System : 91369-24
Display : Color LCD 640x480
System Information
mpc860 masknum : a01
Bus freq(MHz) : 166
VGA vend/dev/vers :
Ethernet vend/dev/vers :
ISA vend/dev/vers :
PCI bridge vend/dev/vers :
FLASH size(MB) : 16
DRAM size(MB) : 32
Diagnostics
Boot error indicators : 00 00 00 00 00 00 00 96
Current error indicators : 00 00 00 00 00 00 00 96
Startup counters A:10 C:10 W:0 P:0
Software Information
Current version : 1.99.02 Apr 15 2004
Boot version : 1.2/2
IRIS version : Unknown
Option string : 1N006
Check sum boot: 0x033CDDEE app: 0x16DA44E0
SYSTEM INFO - DIGITAL
ANALOG
PRINT

*Figure 2-18: System Information screen - Digital*

Touching ANALOG displays the analog system information.

- While the monitor is connected to AC power, **AC** displays below the **AC/DC** heading and the current **battery charge current** and **battery resistance** values display, along with values for various powers and temperatures (actual data may differ from the example in *Figure 2-19*).

voltage %full AC/DC
batteries (A & B) ******* *** AC
battery charge current(A) : 1.20
battery resistance (KOhms) : 2.440
3.3V power used (W) : 2.50
5V power used (W) : 5.19
+/-12V power used (W) : 5.91
Total power used (W) : 13.60
powersupply temperature (C) : 44
digital temperature (C) : 44
line voltage (V) : 17.882
ALL ALARM TONES OFF
SYSTEM INFO - ANALOG
PRINT

*Figure 2-19: Analog system information - monitor connected to AC power*

- If the monitor is not connected to AC power, **DC** displays below the **AC/DC** heading (actual data may differ from the example in *Figure 2-20*), and the current battery **voltage** and **%full** values display, along with values for various powers and temperatures (**line voltage** displays asterisks).

*Figure 2-20: Analog system information - monitor not connected to AC power*

## Define Patient Identifier (PI) String

The network-based Remote View and Alarm Watch features enable caregivers to monitor a patient's condition by displaying that patient's data on monitors not connected to the patient.

To minimize any confusion of patient identity, any monitor that displays more than one patient's data uses a dividing line to separate the data. The monitor also displays identifying information in the waveform zone for every patient whose data is being remotely displayed. The identifying information, which displays in the lower left corner of the waveform zone, consists of the monitor's five-character Monitor Name and a configurable Patient Identifier (PI) string, which can be up to 40 characters in length.

To create the PI string, monitors gather identifying data from the Global Data System (GDS) memory of the remote monitor as required by the PI Config string definition. Monitors then display this PI string to the right of the monitor's name at the bottom of the Remote View or Alarm Watch display zone. This PI string is re-evaluated when a new patient is admitted, a patient is discharged, a bed location changes, or any identifying parameter changes.

At run-time, patient name items defined for inclusion in the PI string may be truncated to ensure they fit within the available display space; general items are never truncated. Monitors also truncate the PI string so that it does not run into or behind the parameter key and to ensure that it does not exceed the 40-character limit.

## Configuring the PI String

Touch DEFINE PI STRING in the **Biomed Level** menu to display the **Define Patient Identifier String** dialog box (*Figure 2-21*).

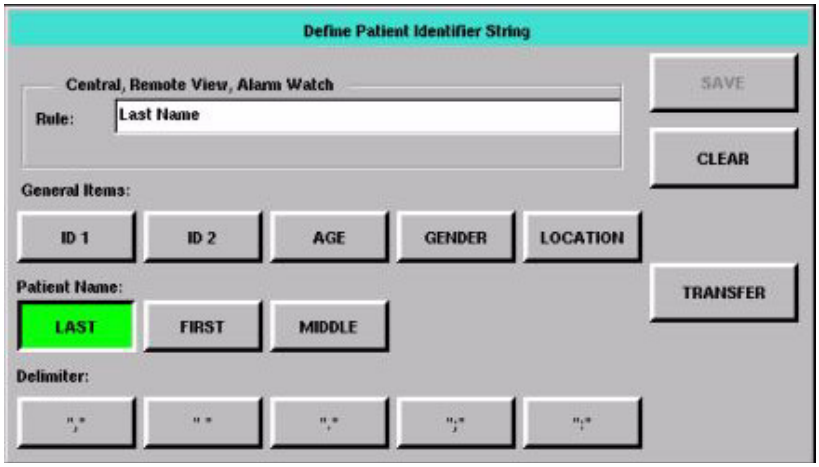



*Figure 2-21: Define Patient Identifier String dialog box*

The current PI string definition is displayed in the **Rule** box and is defined using the three rows of item keys (**General Items**, **Patient Name**, and **Delimiter**). Touch a key in one of these rows to append that item to the end of the Rule's existing contents. The items are appended exactly as they are selected.

For example:

- Selecting the same **Delimiter** (separator) twice inserts that delimiter into the **Rule** box twice.
- Touching AGE and then GENDER inserts the patient's age and gender into the **Rule** box without a separating character.
- Touching AGE, a delimiter, and then GENDER ensures that consecutive items are separated.

No more than two consecutive delimiter strings can be added to the **Rule** box at one time. To display identifying information, the monitor gathers the PI data associated with the items displayed in the **Rule** box from the remote monitor's GDS.

The three keys on the right side of the **Define Patient Identifier String** dialog box enable you to clear, save, or transfer the Rule as follows:

- Touch CLEAR to clear the **Rule** box.
- Touch SAVE to save the contents of the **Rule** box as the PI string definition. Below the **Delimiter** keys, the monitor displays the message *Configuration Saved* if errors are not detected and displays the message *Unable to save PI Config string, try again* if errors are detected.
- Touch TRANSFER to transfer this monitor's PI string definition to other selected monitors.

**To configure the strings on multiple monitors:**

1 Define and save the PI string on one monitor using the **Define Patient Identifier String** dialog box.

2 Touch the TRANSFER key to display the **Transfer Patient Identifier Configuration** dialog box.

***Note:***
*The TRANSFER key is disabled if the **Rule** box is blank or the contents have been changed but not saved.*

3 Select the destination monitors, then touch the TRANSFER key in the **Transfer Patient Identifier Configuration** dialog box to transfer the data to the other monitors. The message *Transfer Complete* displays following a successful transfer.

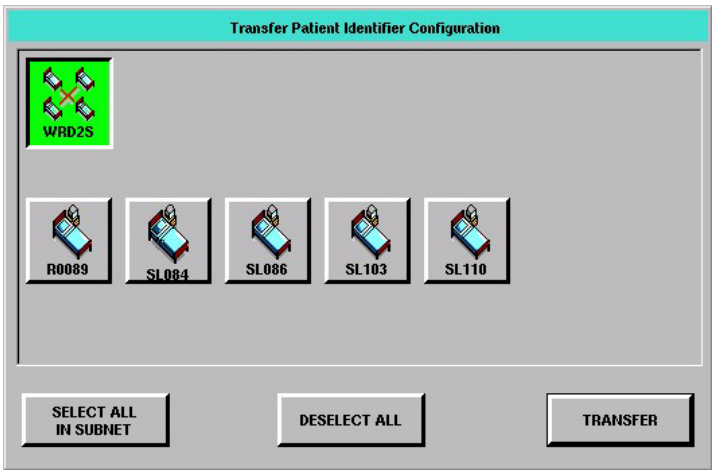



*Figure 2-22: Transfer Patient Identifier Configuration dialog box*

The other two keys at the bottom of the **Transfer Patient Identifier Configuration** dialog box perform the following functions:

- SELECT ALL IN SUBNET — Selects all the monitors within the currently selected subnet with one key touch.
- DESELECT ALL — Deselects all the monitors in all the subnets with one key touch.

The list of monitor keys displayed below the subnet keys may include monitors that do not support the PI string transfer protocol if legacy products are present. Keys for those monitors are always disabled.

***Note:***
*The SELECT ALL IN SUBNET and DESELECT ALL keys are disabled if no monitors that support the transfer protocol exist within the selected subnet. Selection or deselection only applies to the keys for the model 91xxx monitors.*

## Reset Monitor

The RESET MONITOR key in the **Biomed Level** menu allows you to reset the monitor after changing settings for the following items (the monitor must be reset before the changes can take effect):

- Monitor ID
- Monitor Name
- Subnet Name
- IP configurations

Touching the RESET MONITOR key displays the **Reset Monitor** dialog box. Select **Reset Monitor** to proceed or **Cancel Reset** to cancel.

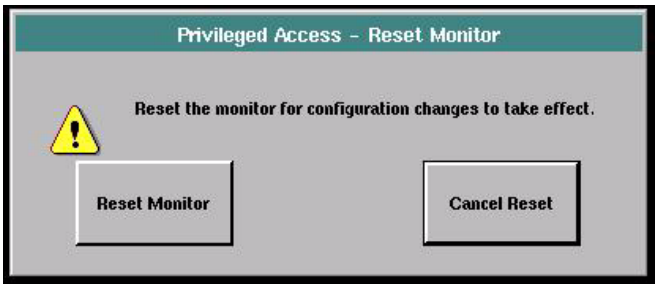

Privileged Access - Reset Monitor
Reset the monitor for configuration changes to take effect.
Reset Monitor
Cancel Reset

*Figure 2-23: Privileged Access - Reset Monitor dialog box*

# Theory

## Contents


Overview . . . . . 1
Major System Components . . . . . 1
Printed Circuit Board Assemblies (PCBAs) . . . . . 4
Interconnect and Connector PCBAs . . . . . 14
Bezel Assembly . . . . . 15
Boot Sequence Overview . . . . . 17
Normal Operation Overview . . . . . 17
Display . . . . . 18
Parameter Modules . . . . . 19
CPU PCBA Connectors . . . . . 20
CPU PCBA Jumpers . . . . . 20
I/O PCBA Connectors . . . . . 21
Interconnect PCBA Connectors . . . . . 21


## Overview

A typical monitor configuration consists of these major components:

- Monitor
- DC power supply
- Parameter module

There may also be additional hardware devices present, such as a mouse, keyboard, and barcode scanner.

The monitor may also be used in conjunction with other hardware components, such as:

- 90491/90499 module housings
- Flexport system interface
- Gas analyzer
- External display

## Major System Components

### Main Enclosure

The main enclosure includes the CPU, Interconnect, and I/O PCBAs, with one integrated module slot. The main enclosure does not include an AC-to-DC power supply. AC-to-DC power conversion is provided by an external DC supply. The external supply provides 18 VDC, which is internally converted to generate appropriate operating voltages.

The data processing and control hardware all reside on a single CPU PCBA consisting of:

- Memory subsystem that incorporates Flash, synchronous DRAM, SRAM, and NVRAM.
- Host subsystem that runs the system software and interacts with peripheral devices.
- Graphics subsystem that generates the display.

## External Connectors

The monitor's external connectors are listed in *Table 1*.

*Table 1: External Connectors*

| Reference | Connector | Description | Pinout | |
|---|---|---|---|---|
| ❷ *Figure 2-3* on page 2-4 | 5-pin DIN male | Power input | 3<br>4 | RETURN<br>+18 Input |
| ❸ *Figure 2-3* on page 2-4 | 9-pin | SDLC connector | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9 | GND<br>Data +<br>Data -<br>+5 V<br>+12 V<br>Clock +<br>Clock -<br>-12 V<br>GND |
| ❹ *Figure 2-3* on page 2-4 | DB15HD female | Alarm relay output | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14 | Alarm 0 Common<br>Alarm 0 Normally Closed<br>Alarm 0 Normally Open<br>GND<br>Alarm 1 Normally Closed<br>Alarm 1 Normally Open<br>Alarm 1 Common<br>GND<br>+12 @ 140 mA<br>GND<br>GND<br>Alarm 2 Normally Open<br>Alarm 2 Common<br>Alarm 2 Normally Closed |

*Table 1: External Connectors (continued)*

| Reference | Connector | Description | Pinout | |
|---|---|---|---|---|
| ❺ *Figure 2-3* on page 2-4 | DB15HD female | Video output | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15 | Red<br>Green<br>Blue<br>ID Bit<br>Self Test<br>Red RTN<br>Green RTN<br>Blue RTN<br>Missing Pin<br>RTN<br>Not connected<br>Not connected<br>H-Sync<br>V-Sync<br>Not connected |
| ❻ *Figure 2-3* on page 2-4 | DB9 female | Serial I/O | 1<br>2<br>3<br>4<br><br>5<br>6<br>7<br>8<br>9 | NC<br>RXD (receive data)<br>TXD (transmit data)<br>DTR (data terminal ready)<br>GDN<br>DSR (data set ready)<br>RTS (ready to send)<br>CTS (clear to send)<br>NC |
| ❼ *Figure 2-4* on page 2-5 | USB | Mouse, keyboard, barcode scanner | 1<br>2<br>3<br>4 | +5 V out<br>Data -<br>Data +<br>GND |
| ❽ *Figure 2-4* on page 2-5 | RJ 45 | Ethernet – 10/100BaseT | 1<br>2<br>3<br>4<br>5<br>6<br>Yellow LED<br><br>Green LED | TD+<br>TD-<br>RD+<br>NC<br>NC<br>RD-<br>ON = 100 Mhz<br>OFF = 10 Mhz<br>Link/Activity |

Connector ❸, Synchronous Data Link Control (SDLC) interface, is electrically compatible with the EIA-RS485 standard. The communications protocol is derived from the IBM SDLC specification and uses its Non-Switched Multipoint Half-Duplex configuration. This interface is compatible with all Spacelabs Medical modules, Flexport Interfaces, gas analyzers, telemetry receivers, and printers.

Connector ❹, alarm relay output, is compatible with third-party alarm devices that conform to the pinout shown in the alarm relay schematics (refer to *Alarm Relay* on page 2-7).

Connector ❺, video output, is a standard 15-pin, high-density, D-Sub connector. The output to the display includes H-sync and V-sync signals, allowing the use of a wide range of third-party displays.

Connector ❻, serial communications interface, conforms to the EIA-RS-232 standard. The baud rate and number of start, stop, and parity bits are software programmable. The default is 9600 baud, 1 stop bit, 8 start bits, and no parity bits.

Connector ❼, Universal Serial Bus (USB), follows the USB1.1 standard. These three ports provide power and communications for USB peripherals, such as a keyboard, mouse, and barcode scanner, that are approved by Spacelabs Medical.

Connector ❽, Ethernet, conforms to the IEEE 802.3 standard for 10/100BaseT.

### External Controls

The power ON/OFF switch located on the front bezel is the only external control for the monitor.

# Printed Circuit Board Assemblies (PCBAs)

## CPU PCBA

***Note:***

*Refer to the list of* Assembly Drawings and Schematics *on page 6-4 for the complete system block diagram.*

The CPU PCBA runs the system software, updates the display, and communicates with peripheral devices through the I/O PCBA. It has four major subsystems (*Figure 3-1*):

- Power Supply
- Core Processor, including all 64-bit peripherals
- PCI subsystem, including 32-bit peripherals
- ISA subsystem, including 16-bit peripherals

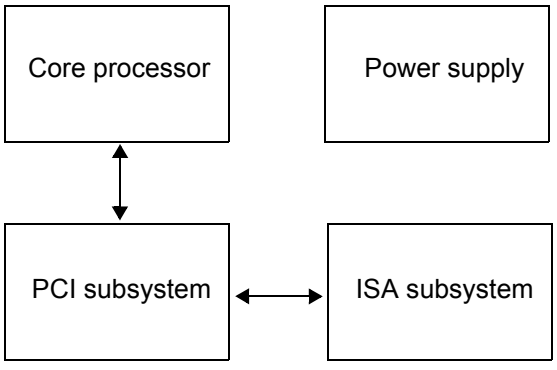



*Figure 3-1: CPU PCBA setup*

## Power Supply Section

The power supply subsystem produces power to drive the entire system, including the CPU, display, parameter module, and battery charger (*Figure 3-2*).

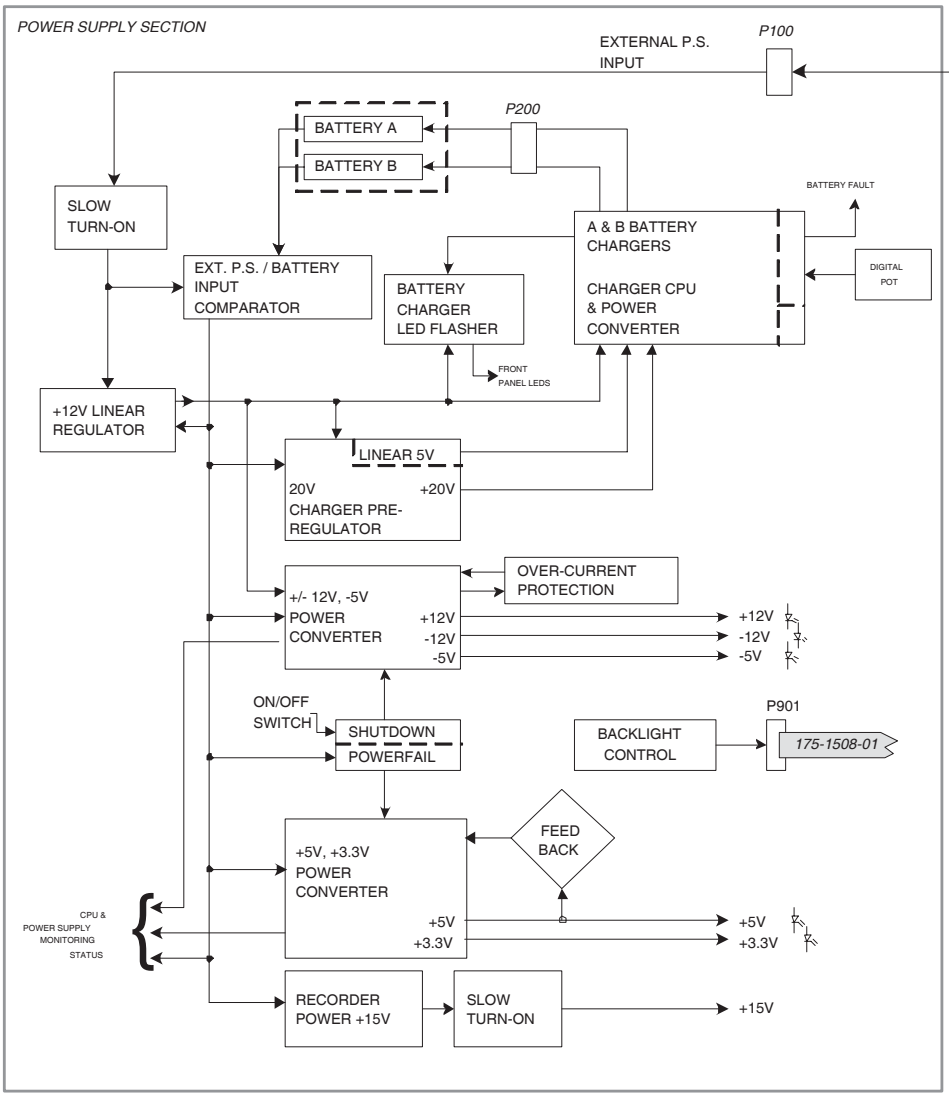



*Figure 3-2: Power supply section*

### Power Supply Connector

Power is supplied to the monitor from an external DC power supply. Power arrives at the CPU PCBA via a single connector, P100, at 18 VDC.

## DC-DC Converters

The internal power supply derives six output voltages for different functions of the CPU PCBA.

- +12 V @ 24 W
- -12 V @ 1.2 W
- -5 V @ 0.5 W
- +15 V @ 3 W
- +5 V @ 15 W
- +3.3 V @ 6 W

In the event of mains power failure, all supplies are maintained through power derived from up to two internal 12 V NiMH batteries.

The power supply subsection has a slow turn-on feature, which prevents high inrush currents when power is switched ON. The power supply will also control which input source to use, either the external power supply or the batteries. The minimum input voltage required to operate the monitor is 11.5 VDC. If the external power supply input is less than 11.5 VDC, and the batteries greater than 10.75 VDC, the monitor will run on battery power.

## Power Failure Operation

The power supply on the CPU PCBA provides a digital signal PFAIL to the CPU to indicate that a power failure condition is imminent. This signal is asserted by the power supply if its input power fails, or if the monitor is switched OFF. This signal is provided through a power supervisor IC to the MPC8270 as an interrupt, causing the processor to take immediate power failure action.

Power failure operation of the monitor takes advantage of the fact that this monitor's design requires at least one charged battery to be present at all times. This battery provides power for the monitor far in excess of the intended three-minute data retention requirement for the module data.

### *Battery Chargers*

The battery chargers have the following features:

- Front panel LED battery charging/failure indicator.
- Automatic "battery care" recharge cycles to ensure a maximum charge.
- Individual battery chargers for each of the two batteries, so that a bad battery will not degrade the other battery.
- If the monitor is OFF, one or two batteries can be fully charged in 90-120 minutes. If the monitor is ON, batteries are charged in four to five hours.

**Charger Pre-Regulator** — The +20 VDC output provides up to 60 W of battery charging power. This DC output voltage is then used as the main power source for charging batteries. The circuit uses a single-ended flyback converter topology. This pre-regulator circuit is active at all times when the monitor is powered from the external power supply voltage.

**Charger CPU IC** — This IC is a pre-programmed microprocessor designed specifically for controlling the charging of batteries. The CPU monitors the voltage and resistance of the batteries while charging and determines when to turn the charger power converter ON or OFF, and can detect faulty batteries. The CPU periodically performs maintenance cycles to keep batteries fully charged.

**Charger Power Converter** — The power converter consists of a LT1511 step-down converter and various discrete components. It is turned ON and OFF under the control of the charger CPU IC. When ON, it charges the batteries with the maximum current that is allowed by the charge rate control circuit.

**Charge Rate Control** — The minimum battery charge rate is always controlled by the battery itself. A battery will only accept the current it is capable of converting to charge inside the cells. However, the control for the maximum battery charge current is controlled in one of two ways. If the monitor is powered from the power supply and the front panel power switch is OFF, the maximum charge current defaults to the maximum current that the batteries can take, which is 1.8 A. If the monitor is powered from the AC/DC power supply and the front panel power switch is ON, the CPU will have control of the maximum battery charge rate via an analog switch and digital potentiometer. The CPU monitors the power consumed by the monitor electronics and adjusts the charge current based on the amount of remaining power available from the power supply.

**Battery Charging LEDs** — A pair of simple op-amp oscillator circuits controls the operation of the two front panel battery charge status LEDs. When either battery is charging, a signal from the charging circuit causes that battery's oscillator to run, which causes the corresponding front panel LED to flash. The two front panel battery charge status LEDs are independent of the front panel power LED. When external power is available, the power LED is constantly lit; this LED is off when external power is not available.

**Battery Fault/Interrupt Signal** — If the battery voltage exceeds the upper limit, the charger CPU IC will power OFF the charger and then attempt to charge again. If the battery voltage exceeds the upper limit again, a 1 Hz signal will be sent to an MPC8270 CPU interrupt input (via the ISA bridge). The software will sense this 1 Hz rate and will indicate a battery failure. If the battery voltage is too low, the process is the same.

**Automatic Fan Control** — The MPC8270 CPU monitors internal temperature via temperature sensors and an A/D. If the temperature exceeds a preset limit, the CPU will run the fan at a normal speed until the temperature is reduced. However, during battery charging, the battery chargers override the CPU and force the fan on at a higher than normal speed. This allows the battery chargers to run at full output without overheating the unit.

***Note:***

*The fan will not operate unless a battery is installed.*

## Core Processor Subsystem

The core processor subsystem includes a memory subsystem and a microprocessor subsystem (*Figure 3-3*). The memory subsystem incorporates Flash ROM, Synchronous DRAM (SDRAM), and Static RAM on the local 60x bus. All are directly controlled by the memory controller of the MPC8270 microprocessor.

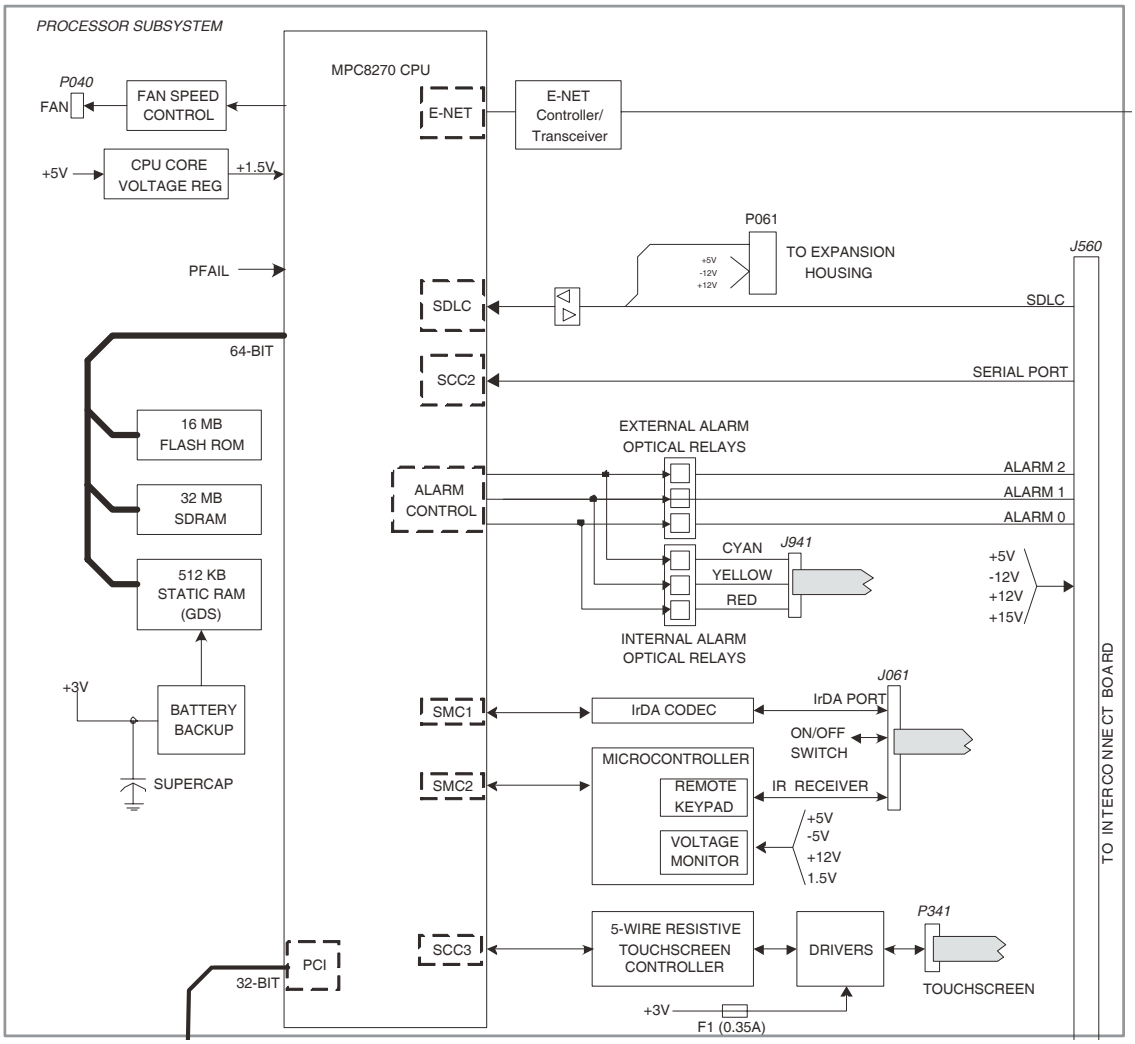



*Figure 3-3: Core processor subsystem*

## Memory

### *Flash ROM Memory*

The Flash ROM contains all code executed by the monitor. Refer to *Boot Sequence Overview* and *Normal Operation Overview* on page 3-17. The Flash ROM is updated via the network interface, using File Transfer Protocol (FTP).

Control over the Flash is done with the GPCM and a dedicated CS0 region, controlling the entire memory bank. Common Flash Interface (CFI) is the communication method. Two banks of Flash memory (Intel Advanced+ BootBlock C3-family, 64 Mbit, x16, 80 ns) are used on each PCBA, providing a total of 16 MB of Flash memory.

### *SDRAM Memory*

In Normal Operation, the CPU executes code directly from SDRAM.

The 32 MB (256 Mbits) SDRAM is refreshed using its auto-refresh mode. Using the SDRAM's periodic timer, an auto refresh command is issued to the SDRAM every 15.6 µs.

### *Static RAM (GDS) Memory*

The Static RAM contains Patient Trend Data and Demographics, known as the Global Data System (GDS).

The monitor contains two banks of 256 KB SRAM that hold the GDS data. They draw their power from the 3 V backup with a minimum of three minutes of battery backup supply, using a SuperCap with the MAXIM 6363 supervisor.

### *Chip Selects*

Chip selects for devices on the 60x bus are generated by the MPC8270 memory controller unit. The monitor uses only three of the 12 available chip selects:

- **CS0** — Boot Flash (controlled by the GPCM)
- **CS2** — SDRAM (controlled by the SDRAM)
- **CS6** — GDS SRAM (controlled by the GPCM)

## MPC8270 Microprocessor

The monitor uses the Motorola MPC8270ZQ processor. Some of the special features include:

- PowerPC G2_LE core processor unit.
- Separate power supply for the internal logic (1.5 V) and for I/O (3.3 V).
- 64-bit data and 32-bit address on the 60x bus.
- 32-bit address/data on the PCI bus.
- Integrated PCI 2.2 compliant bridge, 32-bit data bus, 66 MHz, 3.3 V.
- Twelve-bank memory controller with glueless interface to SRAM, SG1DRAM, and Flash.
- Embedded 32-bit RISC architecture communication processor.

## Ethernet Interface

The MPC8270 contains fast ports on its communication module. The monitor takes advantage of one FCC port (FCC1) for the 10/100BaseT Ethernet port. The interface to the Physical Layer (PHY) is through full Media Independent Interface (MII). Data communication is in Nibble mode (4 TX_D lines and 4 RX_D lines). The RJ-45 connector contains LEDs indicating speed (yellow ON for 100MHz, yellow OFF for 10MHz) and link status (green flashing about once every five seconds for Link Active).

***MII***

The MPC8270 has all the MII pins except bi-directional data line (MDIO) and MDC (clock), which are provided between the PHY chip and MPC8270 GPIO.

- MDIO → PC4
- MDC → PC3

***Fast Ethernet PHY***

An Intel LXT972A is used for Ethernet PHY. This is an IEEE-compliant Fast Ethernet PHY transceiver supporting both 10BaseT and 100BaseT applications.

## SDLC Interface

The SDLC bus is the communications interface to Spacelabs Medical modules, which supply patient data to the monitors. The SDLC interface runs at 1.892352 MHz. This is divided down to generate a 448 Hz sampling rate. The SDLC communication task retrieves the data from the bus, assembles it into a packet format, and provides it to the monitor application. The SDLC clock signals are output by the SDLC interface and are used to drive the external SDLC bus and modules. The SDLC data signals are bi-directional and can be used to both transmit and receive data from the intelligent modules.

## RS-232 (UART)

The RS-232 universal asynchronous receiver-transmitter (UART) uses some UART signals for communication with external devices. Linear Technology LTC1331 RS-232 transceivers are used to provide 3 V interface with the MPC8270. Communication with external RS-232 devices is through the 9-pin DSUB connector and transmission speed is limited to 9600 Kbps.

## Embedded Alarm Light

A “flexible circuit” and PCBA contain circuitry for the embedded alarm light. Five ultra-bright LEDs are used for each color (red, yellow, and cyan) to generate the back light for the lens.

Because alarms are available on the monitor as well as externally, an internal signal is provided (from pin PB26 on the MPC8270), allowing the software to enable/disable the embedded alarm light on the monitor.

At initial power on, the LEDs cycle through at a rate of 4.2 Hz for a duration of two seconds, which is more rapid than the fastest flash rate used for any alarm condition (2.8 Hz). This function allows the user to confirm that all the LEDs are functional.

Optical relays are used for both the embedded alarm light and the external alarm relay output.

## External Alarm Control

During boot diagnostics, all three alarm relays are tested for two seconds. During normal operation, the high-priority alarm relay is activated during high-priority alarms (for example, heart rate), and the medium-priority alarm relay is activated during medium-priority alarms (for example, leads off).

### Remote Keypad (Optional)

The monitor supports the 90360 remote keypad. The communication from the keypad is through 940 nm wavelength infrared, and processing is done in the Motorola MC68HC908 8-bit microcontroller.

### Touchscreen Circuitry

An ELO Graphics Coach chip set is built into the CPU PCBA to handle all communication between the 5-wire resistive matrix touchscreen and the MPC8270 CPU. In addition to the standard UART signals, additional signals from the on-board touchscreen controller (touchscreen sense, wake up, and shutdown) are directly routed to the MPC8270 GPIOs. The current drivers for the touchscreen are sourced from +3 VDC through fuse F1.

### Hardware Reset

Externally driven HRESET* will cause the following:

- Initialize memory controller
- Initialize system protection logic
- Initialize interrupt controller
- Initialize parallel I/O pins

## PCI Subsystem

The PCI subsystem interfaces directly to the PCI Bridge integrated into the MPC8270 processor (*Figure 3-4*). All accesses to the PCI devices are done through this bridge. The monitor supports up to five PCI devices, not including the PCI module integrated into the MPC8270. Not all devices reside on the primary PCI bus. To keep the design modular and simple, only the PCI/ISA bridge, PCI/PCI bridge, and video controller reside on the primary PCI bus. The PCMCIA controller is placed on the secondary PCI bus through the PC/PCI bridge. The USB keyboard and mouse are supported by a USB controller located within the Intel 82371, which is USB v1.1 compliant.

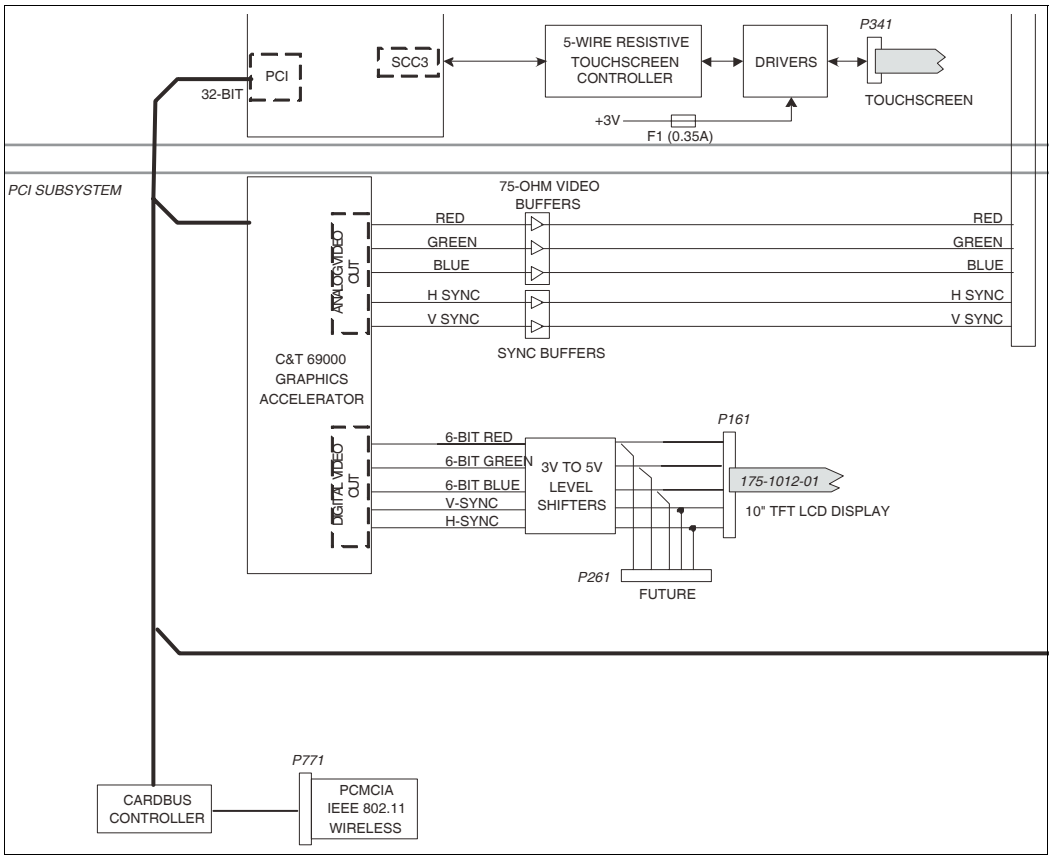



*Figure 3-4: PCI subsystem*

## Video

Video is implemented using an Asiliant 69000 VGA controller that resides on the PCI bus. The video system uses 2 MB of internal RAM for video memory. The video controller directly generates digital video signals for the liquid crystal display. It also generates equivalent analog RGB signals, which are buffered and sent to the external VGA connector for connection to an external display. H-sync and V-sync signals are also routed to the VGA connector.

## PCI/PCMCIA Controller

An internal, 68-pin, PCMCIA socket connector is standard and is the interface for a (future) PCMCIA IEEE 802.11(a/b/g) Wireless Network Card. A Texas Instrument PCI2250 has an OverCurrent detection output, which is fed directly to a GPIO on the MPC8270. Software can take action, if desired, on the assertion of this pin (for example, PCMCIA shutdown).

The PCMCIA controller has a direct interrupt line to the MPC8270 CPU through IRQ3.

## PCI/ISA Bridge

An Intel 82371EB South Bridge, which is part of the Intel Chipset 440BX, is used to simplify software porting. The Bridge is the interface between the 32-bit PCI bus and the 16-bit ISA bus. The ISA bus is maintained for the support of Audio CODEC, NVRAM, and ISA wireless interface.

The Bridge also contains the USB Root Controller, which connects to and controls the 4-port USB hub.

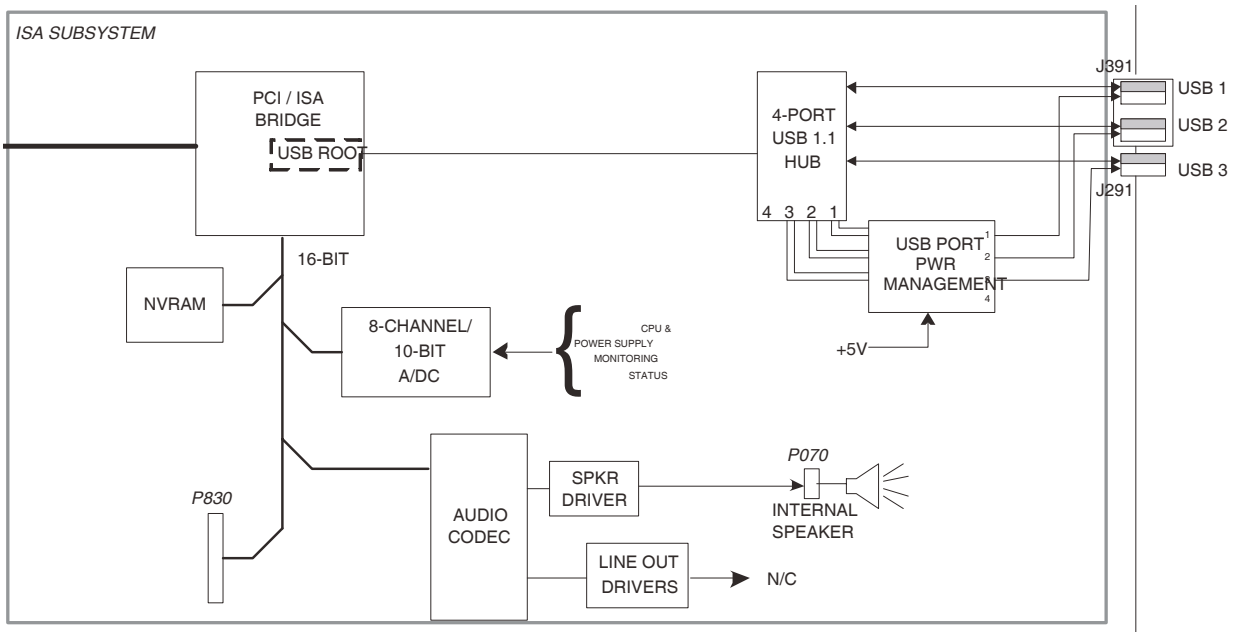



*Figure 3-5: ISA subsystem*

### NVRAM

Non-volatile RAM (NVRAM) is used for SysGen, error logging, and time/date keeping. It is implemented with a Dallas Semiconductor DS1644 non-volatile timekeeping RAM. It is a highly integrated device, containing the following:

- 32 K × 8 static RAM.
- Lithium battery with a 10-year life.
- Time-of-day clock with ±1 minute per month accuracy.
- Power-fail circuitry to protect the clock and RAM on power OFF.
- CMOS Static RAM: stores all Configuration Data in 32K bytes.
  - User-defined defaults
  - Biomed- and clinical-level settings
  - Passwords
  - Sysgen Settings
  - Event Log
  - Touchscreen Calibration Data

### Eight-Channel ADC

The 8-channel, 10-bit ADC is used to monitor power supply functions, including voltage and temperature.

### Audio CODEC

An Analog Devices AD1845 produces the sound generation for the monitor. It drives an amplifier for the internal speaker. Line Out functionality is not currently supported.

## Interconnect and Connector PCBAs

The Interconnect PCBA plugs directly into the CPU PCBA via J1 (*Figure 3-6*). It provides power distribution and EMI filtering for:

- (Optional) Recorder
- (Optional) Recorder CPU
- SDLC (module)

The Interconnect PCBA also provides a signal pass-through to the Connector PCBA, which contains:

- Serial Port
- Analog Video
- External Alarm Relay Output
- SDLC

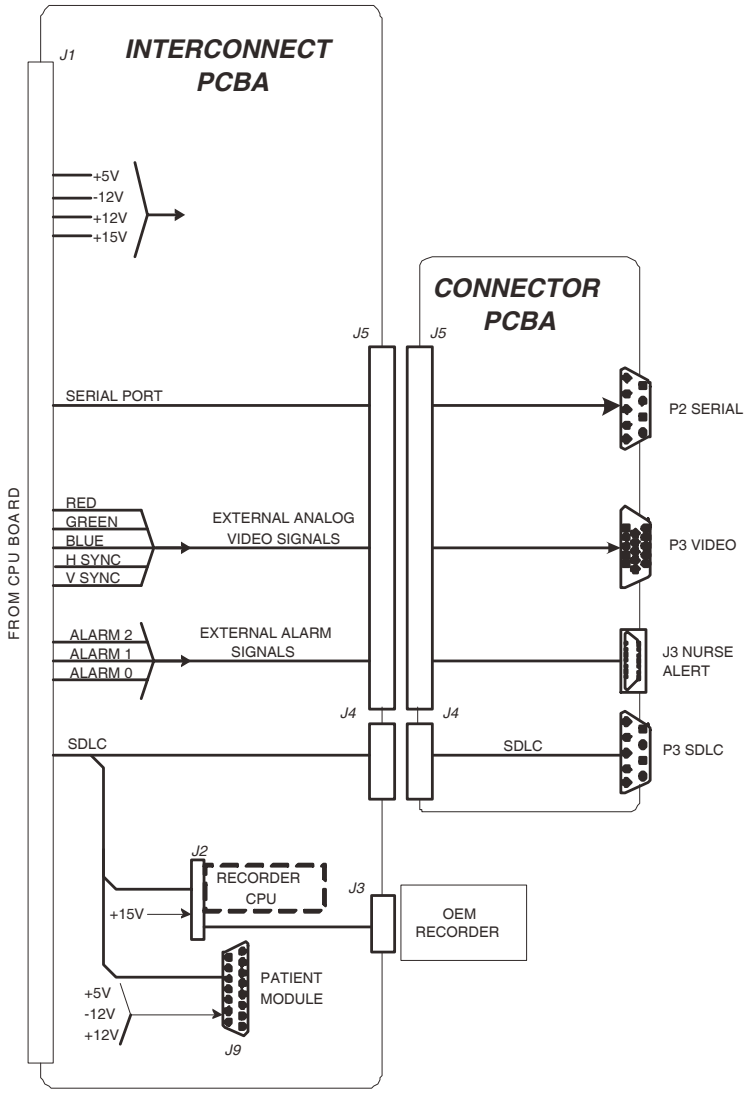



*Figure 3-6: Interconnect and Connector PCBAs*

# Bezel Assembly

The Bezel Assembly is comprised of four items (*Figure 3-7*):

- Power indicator PCBA
  - Battery charger status LEDs
  - AC mains LED
  - Power ON/OFF switch
  - Infrared receiver
  - Direct cable connection to CPU PCBA J061 for battery status, mains connected, infrared, and power switch

- 10-inch TFT color LCD display
  - Digital video via direct cable connection from CPU PCBA P161
  - Backlight power converter
  - Backlight
- 5-Wire resistive touchscreen
  - Elo Touchsystems E271-2210 compatible
  - Direct cable connection to P341 on CPU PCBA
- Embedded alarm light assembly
  - Direct cable connection to P941 on CPU PCBA
  - Three banks of LEDs: cyan, yellow and red.

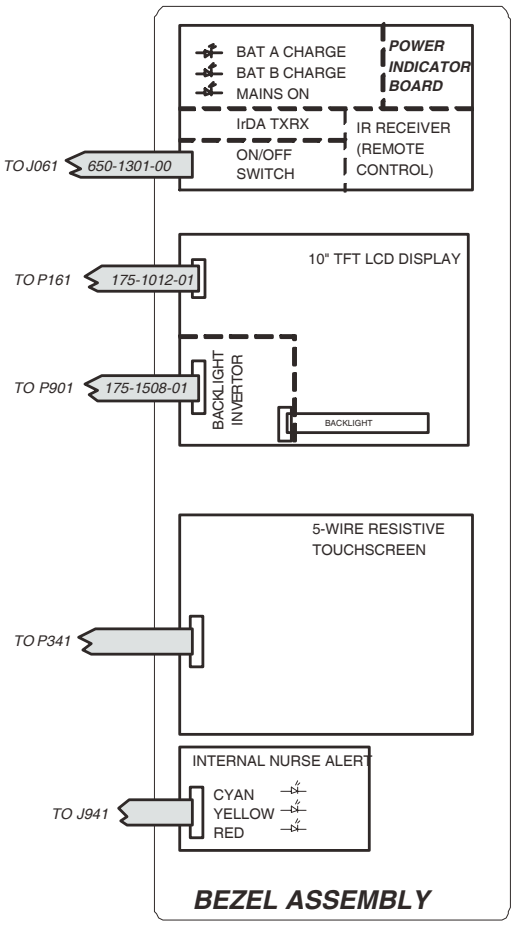



*Figure 3-7: Bezel assembly*

# Boot Sequence Overview

When power is applied, the monitor begins its boot-up sequence. The following is a highly abbreviated version of the sequence of events that occurs while the monitor is booting.

1. Program execution starts in Flash ROM.
2. Key internal and external devices and memories are mapped and enabled.
3. The boot-type value is read from Static RAM. This value is written to Static RAM, which is backed up by a “super cap,” at every power-down or self-reboot. The value determines the kind of boot: warm or cold. Warm booting maintains all data, then skips diagnostics and other steps in order to restore monitoring as soon as possible.
4. Key areas of SDRAM are tested (cold boot only).
5. The boot code is copied from Flash ROM to SDRAM, where program execution resumes.
6. More internal and external devices are initialized.
7. Other key memory and CPU tests are performed (cold boot only).
8. Drivers needed for diagnostics and the boot console are installed.
9. Diagnostics are run (cold boot only).
10. Boot screen and the “3-2-1” countdown are displayed (cold boot only).
11. The VxWorks kernel and the application code are copied from Flash ROM to SDRAM, where program execution continues.
12. The VxWorks kernel is started, and all internal and external devices are reinstalled and initialized.
13. The monitor application code is started, and normal monitor operation begins.

# Normal Operation Overview

This is a high-level summary of what the software does as part of its normal operation.

Once the monitor is booted, it begins normal monitor operation. Normal operation can be viewed as several high-level software and subsystem tasks running simultaneously. These interface to other tasks, and all the tasks interface to hardware devices via device drivers.

## Main Subsystems and Tasks

The SDLC subsystem sends packets from the modules to the rest of the system, including Ethernet and GDS, and it also sends packets to modules.

The Interpreter subsystem provides modules and keys with “primitives” that they use, via table code, to create and control their user interface on the monitor. The Keys subsystem handles touchscreen key presses. It receives key presses from the user and notifies the keyboard interpreter, which then runs the appropriate table code program. That program uses the key display task to redraw the new key state as feedback to the user.

The Global Data System (GDS) is the patient database with parameter data from the modules. It contains current, general, trend, and waveform data.

The Remote Interface system handles Ethernet connections to remote monitors and modules. It also:

- Broadcasts the existence and configuration of network devices to each other.
- Allows remote parameter attaches and remote key press connections across the network.
- Downloads the module table code to remote monitors to create the same user interface on multiple monitors.
- Supports the Alarm Watch and Remote View functions.
- Handles multicast waveform data.

The Recorder subsystem controls local and network printers.

The Alarm subsystem handles the standard alarms. Modules send alarm conditions over SDLC and, in response, the alarm subsystem sends alarm messages to the tone, display, record, and network tasks. It receives messages from the network for Alarm Watch alarms and from SDLC tasks for module/channel adds or deletes.

# Display

The internal display is a 640 x 480, active matrix, thin-film-transistor (TFT) color Liquid Crystal Display (LCD). It receives 18 data signals, 4 timing signals, +5 V and ground. Backlight voltage is produced via an attached 1000 VAC inverter.

The pinout of the display connector (at the display) is provided in *Table 2*. The backlight is connected via a separate 3-pin connector.

*Table 2: Display Connector Pinouts on CPU PCBA P161*

| Pin Number | Symbol | Description |
|---|---|---|
| 1 | GND | |
| 2 | CLK | |
| 3 | HSYNC | Horizontal Sync |
| 4 | VSYNC | Vertical Sync |
| 5 | GND | |
| 6 | R0 | Red Data LSB |
| 7 | R1 | |
| 8 | R2 | |
| 9 | R3 | |
| 10 | R4 | |
| 11 | R5 | Red Data MSB |
| 12 | GND | |
| 13 | G0 | Green Data LSB |
| 14 | G1 | |
| 15 | G2 | |
| 16 | G3 | |

*Table 2: Display Connector Pinouts on CPU PCBA P161 (continued)*

| Pin Number | Symbol | Description |
|---|---|---|
| 17 | G4 | |
| 18 | G5 | Green Data MSB |
| 19 | GND | |
| 20 | B0 | Blue Data LSB |
| 21 | B1 | |
| 22 | B2 | |
| 23 | B3 | |
| 24 | B4 | |
| 25 | B5 | Blue Data MSB |
| 26 | GND | |
| 27 | ENAB | Settle the horizontal display position |
| 28 | VCC | +5 V |
| 29 | VCC | +5 V |
| 30 | R/L | Horizontal display mode select |
| 31 | U/D | Vertical display mode select |

# Parameter Modules

Any single-high Spacelabs Medical parameter module can be inserted into the module slot of the monitor.

The module receives +5 VDC, +12 VDC, and -12 VDC power from the monitor and communicates with the monitor via an SDLC data bus. In the most general terms, the module initially downloads a program (“table code”) into the monitor over the SDLC bus. This enables the monitor to interpret messages from/to the module. The module sends events and data to the monitor, which typically cause the monitor to display waveforms, keys, etc. The monitor also responds to key presses of the module’s keys, which causes various actions to occur, such as changing the way data is displayed.

For more information on the SDLC data bus, refer to *SDLC Interface* on page 3-10.

The theory of operation of a particular module can be found in that module’s service manual.

# CPU PCBA Connectors

*Table 3* provides a summary of all CPU PCBA connectors.

*Table 3: CPU PCBA Connectors*

| Reference | Connector Type | Description |
|---|---|---|
| J191 | RJ45/external | Ethernet connector |
| J291 | USB (single)/external | Keyboard/mouse/standard USB |
| J391 | USB (dual)/external | Keyboard/mouse/standard USB |
| J560 | 80-pin/internal | Interconnect PCBA |
| J941 | 0.1 ctr 10-pin/internal | Alarm connector |
| P590 | 2 x 5 header/internal | USB header |
| P710 | 0.1 ctr 10-pin/internal | Jtag port |
| P960 | 2 x 8 header | Development Port |

# CPU PCBA Jumpers

The CPU PCBA also has several jumpers for various configuration and testing purposes. These are summarized in *Table 4*.

*Table 4: CPU PCBA Jumpers*

| Reference | Description | Default | Configuration | Comments |
|---|---|---|---|---|
| P040 | Fan | Open | | No jumper |
| P100 | Power input | Open | | No jumper |
| P200 | Battery connector | Open | | No jumper |
| P250 | Display voltage | 1-2 | 1-2 — Color TFT/EL<br>2-3 — Color TFT<br>Open | 5V display<br>3V display<br>Display disabled |
| P410 | Battery charger debug | 1-2 | 1-2 — Normal operation | |
| P412 | | Open | 2-3 — Debug mode<br>Open | <br>Charger off |
| P590 | Onboard USB | Open | | Not used, no jumper |

*Table 4: CPU PCBA Jumpers (continued)*

| Reference | Description | Default | Configuration | Comments |
|---|---|---|---|---|
| P710 | PLD programming header | | | JTAG programming |
| P750 | CPU reset configuration | 1-2 | 1-2 — Initial PCBA bring up<br>2-3 — Normal operation | Pulls RSTCONF# high<br>Pulls RSTCONF# low |
| P990 | SuperCap discharge | Open | Open — Normal operation<br>Closed — Discharges SuperCap | |

# I/O PCBA Connectors

*Table 5: I/O PCBA Connectors*

| Reference | Connector Type | Description | Internal/External |
|---|---|---|---|
| P1 | 9-pin D | SDLC | External |
| P2 | DB9 | RS-232 Serial Interface | External |
| P3 | DB15HD | Video output | External |
| J3 | 14-pin D | Alarm relay | External |

# Interconnect PCBA Connectors

*Table 6: Interconnect PCBA Connectors*

| Reference | Connector Type | Description | Internal/External |
|---|---|---|---|
| J1 | 80-pin | CPU PCBA | Internal |
| J2 | 30-pin | RCU PCBA | Internal |
| J3 | 50-pin | Recorder | Internal |
| J4 | SDLC | INTFC to CPU | Internal |
| J5 | Misc. signals | INTFC to CPU | Internal |
| J6 | Ethernet | INTFC to CPU | Internal |
| J9 | 15-pin | SDLC | Internal |

# Contents

Overview . . . . . 1
Mechanical Inspection . . . . . 2
Electrical Safety Testing . . . . . 2
Preventive Maintenance . . . . . 4
Functional Tests . . . . . 5
Assembly/Disassembly Procedures . . . . . 7
Cleaning . . . . . 19

# Overview

The following information describes the requirements and tests necessary for safety and performance verification of the monitor.

**Caution**

**Observe precautions for handling electrostatic-sensitive devices!**

***Note:***

- *Never touch electrostatic-sensitive electronic components without following proper anti-static procedures, including the use of an ESD wrist band and mat. An electrostatic discharge from your fingers can permanently damage electronic components and cause latent failures.*
- *All static-sensitive electronic components are packaged in static-shielding bags. Retain the bag for repackaging the component should you need to store it or return it to Spacelabs Medical for any reason.*
- *Cleaning, preventive maintenance, and safety checks should be performed annually and following any product disassembly/assembly. Preventive maintenance and safety checks must be performed by trained personnel only.*

## Required Test Equipment

- Electrical Safety Analyzer — Dynatech Nevada 232C or equivalent
- Patient Simulator — Dynatech Nevada 300B or equivalent

***Note:***

- *Before testing, ensure that the module housing(s) and its DC power supply(s) have their associated cables attached, but are not interconnected.*
- *Ensure that the Ethernet cable and AC power sources are removed.*
- *The AC line is auto detected; no user selection is necessary.*
- *Ensure that the leakage test equipment is calibrated.*

# Mechanical Inspection

Verify that:

- The monitor and all optional equipment are clean.
- All screws are tight.
- The case and connector pins are not damaged.
- There are no frayed or pinched wires or cables.

# Electrical Safety Testing

Safety testing protects the patient from electrical shock, especially micro-shock. It has been determined experimentally that current values in the microampere (μA) range may cause fatal arrhythmias in electrically susceptible patients. A patient is deemed electrically susceptible when connected to monitoring equipment.

## Definitions

**Classification** — IEC/EN/UL 60601-1 Safety standard designation for the class of equipment and type of patient applied parts that indicate the degree of protection provided against electrical shock.

**Leakage Current** — Current that is not functional. It includes patient leakage, ground leakage, and enclosure (or chassis) leakage.

**Patient Lead Leakage** — Current that flows from the applied part of the patient lead to ground.

**Chassis Leakage** — Current flowing from the enclosure (or from conductive parts accessible to the operator) through the ground conductor.

**Normal Condition** — Condition in which all means provided for protection are intact. Includes, ground connections, insulation, creepage and clearance distances.

**Single Fault Condition** — Open ground, open neutral, line voltage on a patient connection, or any single state other than normal condition that could compromise patient safety.

**UUT** — Unit Under Test.

Spacelabs Medical does not endorse standards to the exclusion of others. Therefore: **BE SURE TO CHECK YOUR LOCAL REQUIREMENTS TO ENSURE YOUR EQUIPMENT SAFETY TESTS COMPLY WITH LOCAL STANDARDS**. Generally accepted standards for medical monitoring equipment, such as the Underwriters Laboratory (UL) and the National Fire Protection Association (NFPA) standards, are summarized in *Table 1*.

*Table 1: Summary of Standards for Medical Monitoring Equipment*

| International Mains to Chassis Leakage | US (120 V) Mains to Chassis Leakage | Mains Resistance |
|---|---|---|
| 100 μA - normal condition, ground attached (AC connector to chassis) | 300 μA - normal condition, ground attached (AC connector to chassis) | 500 milliohms* |
| 500 μA - single fault condition, open ground or reverse polarity | 300 μA - single fault condition, open ground or reverse polarity | 500 milliohms* |
| ** Measured from the AC Power cord third wire ground to the most distant ground attachment* | | |

### Equipment Required

Electrical Safety Analyzer, Fluke model 232D or equivalent.

These tests should be performed according to the hospital's scheduling requirements, at least annually or after repair or modification.

***Note:***

*All tests must be performed according to the safety analyzer's operations manual, and any local requirements.*

***Warning***

***Before starting safety tests, ensure that no patient is connected to the device under test. If safety tests must be performed on equipment currently monitoring a patient, obtain permission to disconnect the cables from the monitor and patient.***

## Ground Resistance

1. Attach the power cord to the monitor under test, then measure the resistance from the AC power cord third wire ground to a chassis location, such as the equipotential post on the rear of the monitor.
2. Verify that the resistance is less than 500 milliohms (0.5 ohms).

## Chassis Leakage Current Tests

1. Plug the leakage analyzers into mains power.
2. Plug the equipment into the analyzer's AC receptacle.
3. Verify that the leakage current from the chassis to ground is less than the values in *Table 2*.

*Table 2: Enclosure Leakage Test Conditions and Limits*

| Neutral Condition | Ground Condition | Polarity | International Limit | U.S. Limit |
|---|---|---|---|---|
| Closed neutral | Closed ground | Normal polarity | 100 μA | 300 μA |
| Open neutral | Open ground | Normal polarity | 500 μA | 300 μA |
| Closed neutral | Open ground | Normal polarity | 500 μA | 300 μA |

## Patient Lead Leakage Current Tests (Patient Modules)

Before you can perform the Patient Lead Leakage Current Test, verify that the monitor passes the ground resistance and chassis current leakage tests. It is recommended that the equipment be operating for 30 minutes prior to the test to allow thermal stabilization. If a 12-lead patient cable is used with the module being tested, perform the tests using the 12-lead cable.

1. Patient Leads Current Leakage — measure the leakage current between each of the patient leadwires and the ground lug on the monitor back panel. Also, measure the leakage current between all combinations of ECG leads and ground. The current must be less than 10 μA with the ground connected, and 50 μA with the ground open.
2. Leakage Current to Ground with 50/60 Hz — AC mains voltage applied to leads. Apply AC mains voltage and measure the leakage current between each of the ECG leadwires and the ground lug on the monitor back panel. The current must be less than 50 μA at any line voltage.

# Preventive Maintenance

A Spacelabs Medical Field Service Engineer or qualified hospital biomedical technician should check the monitor and optional equipment for acceptable performance and electrical safety to ensure they operate according to current requirements.

## Error Log

***Note:***
*The monitor's error log can be reviewed and printed from the **CSR** menu or the **Extended Diagnostics** menu, but not from the **Biomed Level** menu.*

1. To review the monitor's error log, touch the DISPLAY ERROR LOG key.
2. To print the monitor's error log, touch the PRINT LOG key. (The printout will be sent to the printer defined in the **Network Setup** menu.)
3. To clear the monitor's error log, touch the CLEAR LOG key.

### Touchscreen Calibration

In the event the touchscreen becomes difficult to use or a replacement has been installed, you may need to calibrate it. This can be performed using the calibration function in the **Biomed** menu.

To perform the calibration, attach a mouse (in the event the touchscreen is unusable) and perform the following:

1. Power ON the monitor with the mouse attached and wait for the monitor to pass the self tests.
2. Click (or touch) the MONITOR SETUP key and then click (or touch) the PRIVILEGED ACCESS key.
3. Enter the Biomed password (default is **Biomed**).
4. Click (touch) MONITOR CALIBRATION.
5. Click (touch) TOUCHSCREEN CALIBRATION and wait for the **Reset Monitor** dialog box to display. Click (touch) the RESET MONITOR key. The monitor will reset.
6. After 15 to 20 seconds, a lighted box will appear in the upper left corner of the screen. Touch the lighted box for one or two seconds until it disappears.
7. Two more lighted boxes will appear, one at a time, in the upper right and lower right corners. Touch them as they appear.
8. After touching these three corners one at a time as the boxes appear, the touchscreen is calibrated.

## Functional Tests

### Monitor Self-Test

A power-ON self-test is performed each time the monitor is turned ON.

- The power ON/OFF switch (refer to *Figure 2-1* on page 2-2) illuminates indicating +5 V is present.
- If the monitor is operating on external AC power, the power LED on the front bezel also illuminates.
- If the monitor is operating on AC power and batteries are being charged, the battery A and battery B status LEDs on the front bezel flash ON and OFF at a constant rate. Once the batteries are fully charged, these LEDs remain ON. If no battery is present, one or both of the battery status LEDs will remain OFF.

### Monitor Functional Tests

This procedure verifies operation of the recorder assembly, network connectivity, alarm relay output, and external SDLC connections. It assumes that a 91496 multiparameter module (ECG, RESP, two PRESS channels, and two TEMP channels) is available for testing purposes. In the event that these parameters are not available, similar modules may be substituted.

## Verifying Monitor Functions

***Note:***

*To begin the test, make sure no modules are inserted and no Flexports or other SDLC devices are connected.*

1. Plug in the monitor and verify that the front bezel power LED is lit. If one or two batteries are installed, verify that the appropriate battery LED(s) are ON solid or flashing.
2. Press the power ON/OFF switch to turn ON the monitor and verify the following sequence of events:
   - **a** The power ON/OFF switch illuminates.
   - **b** The embedded alarm light LEDs illuminate briefly. Verify that all LEDs are functional.
   - **c** The **Diagnostic** menu displays. (If errors are noted during power-up, contact your Spacelabs Medical Field Service Engineer.)
   - **d** If batteries are installed, the fan begins operating within 60 seconds after turning ON the monitor. The fan will then turn OFF unless the internal temperature requires additional cooling by the fan.
   - **e** Monitor keys display along the right side of the screen.
3. Insert the ECG module without a patient cable connected. Verify that the ECG parameter key appears on the screen with **???** and the message LEADS OFF.
4. Connect a patient simulator to the ECG input with a patient cable. Set the simulator to a known rate and verify that the ECG count and the lead being monitored are displayed to the right of the ECG parameter key. Also verify that the ECG waveform appears on the screen.
5. Connect a patient simulator to the invasive pressure inputs.
6. Zero the pressures and verify that the numerics and waveforms are accurate.

## Optional Recorder Assembly

If the monitor is configured with the optional recorder assembly, verify that the monitor initiates a recording by touching the RECORD key and then touching one of the flashing parameter keys.

***Note:***

*The printed waveform should be free from defects such as gaps, extra lines, etc. If not, notify a Spacelabs Medical Field Service Engineer for servicing, or replace the recorder (refer to* Recorder *on page 5-17).*

## Alarm Relay Output

If the monitor is configured to use the alarm relay output to interface to an external alarm device:

1. Plug the cable into the external alarm connector and initiate a high-priority alarm. Verify that the external alarm responds appropriately.
2. If an external alarm light capable of displaying multiple colors is attached, turn the high-priority alarm OFF and generate a medium-priority alarm. Verify that the external alarm responds appropriately.
3. Repeat step 2 for a low-priority alarm.

An alternate method is to connect the cable and turn the monitor ON and then OFF. Each color of the embedded alarm light will momentarily illuminate. An external alarm light will also briefly illuminate.

### Ethernet (Wired)

1. Attach a 10/100BaseT cable from an active network onto the side panel connector.
2. Touch the SPECIAL FUNCTIONS key and verify that other monitors appear in the **Remote View** menu.

# Assembly/Disassembly Procedures

**Caution**

**Before beginning any disassembly procedures, power OFF the monitor, disconnect the AC cord from the AC power receptacle, and remove the batteries.**

***Note:***

*The external power supply is not designed for disassembly.*

## Required Tools and Parts

- Anti-static mat with wrist strap
- #1 and #2 Phillips-head screwdriver
- 5/16-inch nut driver
- 3/16-inch nut driver

## Setup for Disassembly

1. Remove the external power supply cable and battery(ies) if present.
2. Remove the patient parameter module.

## Installing or Replacing the Optional Recorder Assembly

***Note:***

*Unless purchased separately for a monitor already in the field, the recorder option is installed at the factory. Order an upgrade from your local Sales Representative.*

The recorder option consists of two components: the recorder module and the recorder CPU PCBA.

The recorder CPU PCBA and recorder module fit into the upper slot on the monitor's left side (refer to *Figure 4-1*). The recorder CPU PCBA must be installed first, followed by the recorder module. Refer to *Table 1* on page 6-1 for the recorder CPU and recorder assembly part numbers.

## Installing the Recorder

***Warning***

***A safety hazard is created if the mylar insulator is not properly installed over the recorder CPU PCBA.***

1. Turn OFF the monitor.
2. Remove the printer “dummy panel” by removing the screw located in the top portion of the battery compartment.
3. Remove the recorder hold cover and insert the recorder CPU into the connector located at the bottom of the recorder compartment.
4. Tighten the thumbscrew to secure it to the bottom of the recorder compartment after fully inserting the PCBA into the connector.
5. Install the insulator sheet between the bottom of the printer and newly installed recorder CPU PCBA.
6. Insert the recorder assembly, ensuring that it fully engages the connector at the back of the recorder compartment. Press the release bar to open the recorder assembly and tighten the two phillips-head screws located at the rear of the recorder.

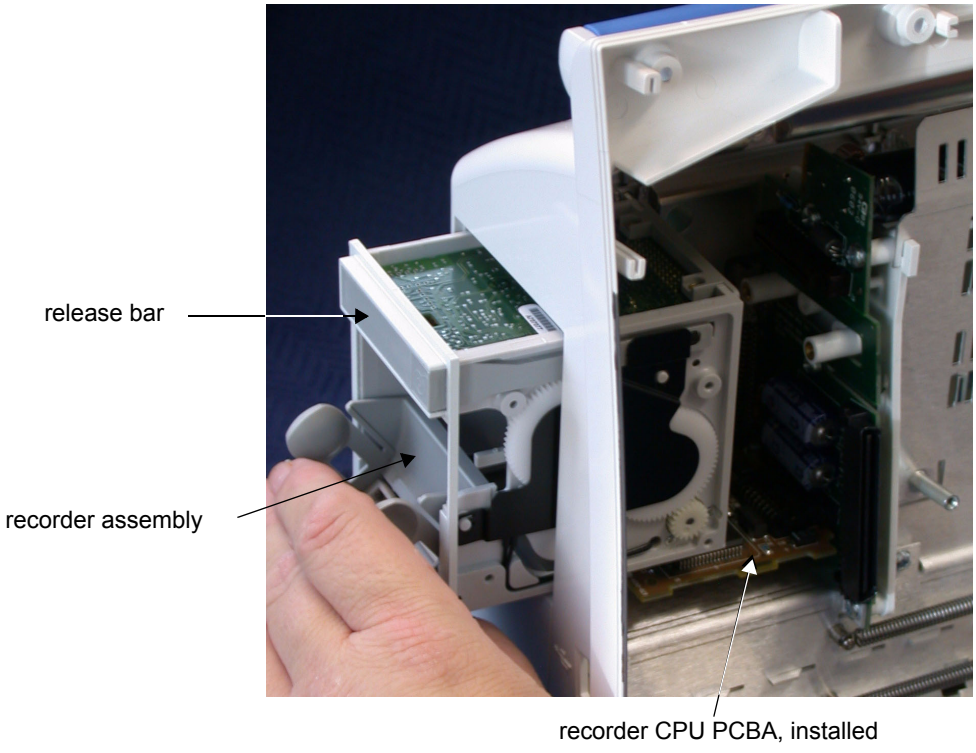



*Figure 4-1: Recorder assembly and CPU PCBA*

## Replacing the Recorder

1 Remove the recorder assembly (if installed) by first opening the printer door, loosening the two captive screws, and then pulling out the assembly at the top.

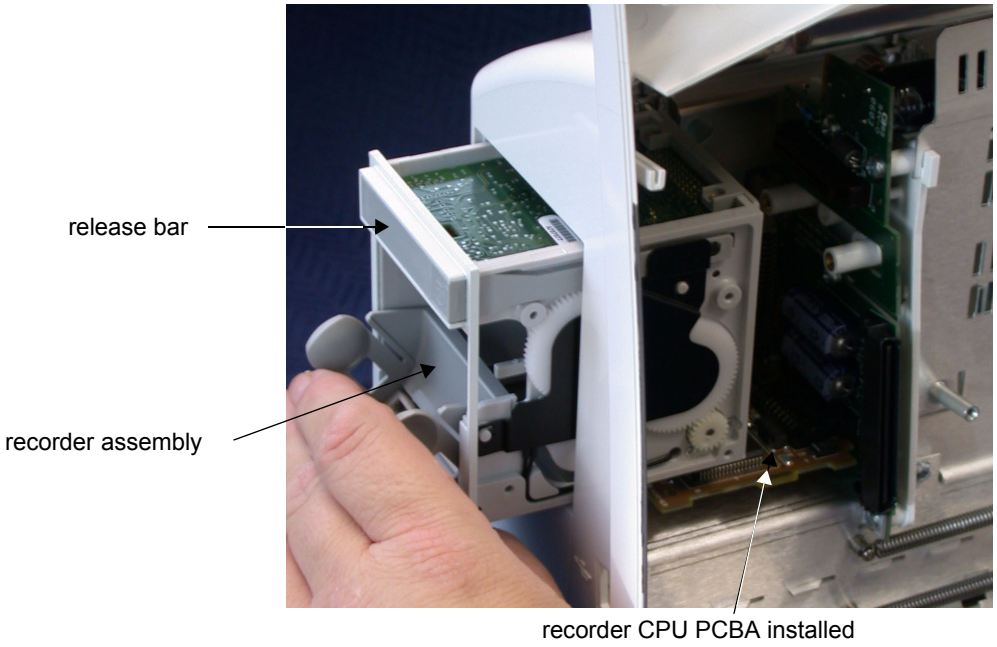



*Figure 4-2: Optional recorder assembly*

2 If replacing the recorder CPU PCBA, loosen the thumbscrew and pull it forward until it is free of the connector.

*Figure 4-3: Recorder CPU PCBA*

3 Reverse procedure to re-assemble.

## Inserting Recorder Paper

Two rolls of thermal recorder paper have been included with the optional recorder assembly. To insert a roll of paper:

1. Press the right side of the release bar at the top of the recorder assembly. The front of the recorder assembly is hinged at the bottom and will drop open, revealing two spoon-shaped arms that hold the paper roll spindle between them.
2. Unroll a short length of paper from the roll, and orient the roll so that the paper feeds from the bottom.
3. Slip the paper roll spindle between the plastic arms, and close the front of the assembly so that the end of the paper roll protrudes out of the recorder assembly just below the release bar.

## Removing the Bezel Assembly

1. Remove the bezel by removing the five screws along the bottom of the enclosure, and then stand the monitor upright and remove the four screws along the top of the bezel.

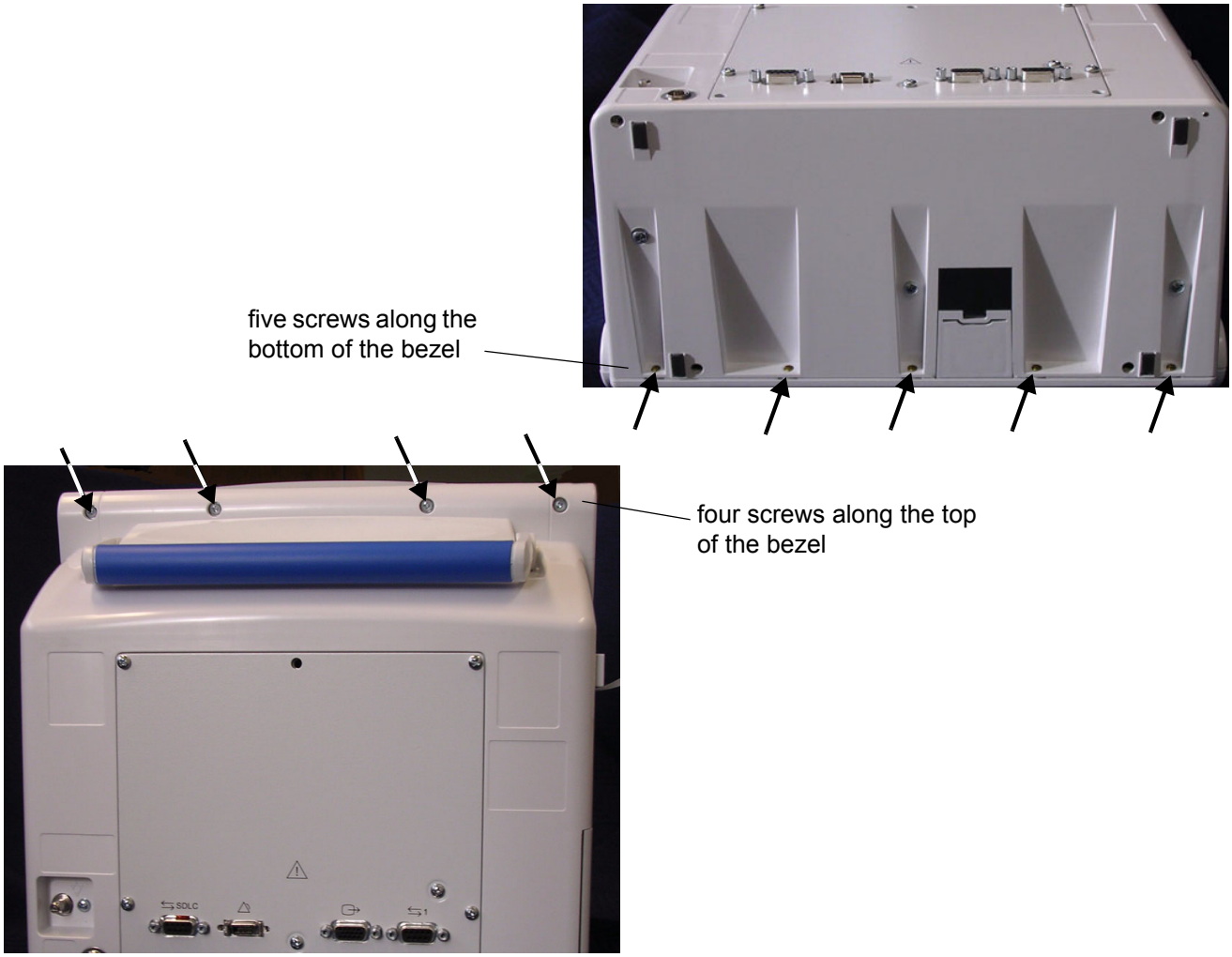



*Figure 4-4: Bezel screw locations*

2 With the monitor standing upright, gently move the top of the bezel and disconnect the flat cable running from the display to the CPU PCBA.

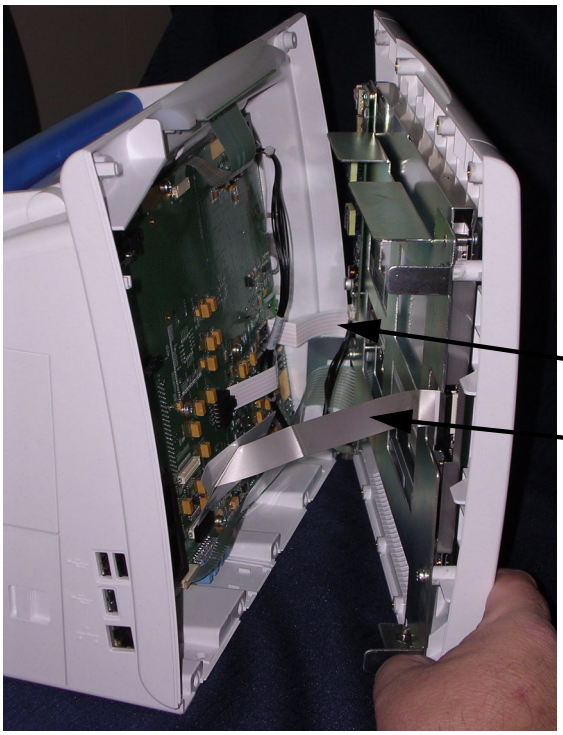



*Figure 4-5: Removal of the front bezel*

**Caution**

- **Never pull on the flex cable. This may damage the cable end or the connector.**
- **Take care when handling cables and connectors. They are fragile and can be damaged.**

***Note:***

- *Due to the short length of the video cable, remove it prior to fully opening the case.*
- *Proper operation of the monitor depends upon correct cable re-insertion following disassembly. Ensure that the flex cable is aligned properly and fully inserted into the connector prior to locking the connector tab down.*

3 Remove the touchscreen five-wire cable from the CPU PCBA.

4 Remove the power switch/monitor assembly by sliding the “ZIF” connector locking mechanism outward, then removing the cable from the socket.

5 Unlatch the touchscreen cable and remove the eight 6-32-inch x 1/4-inch screws (three along the top, three in the center, and two at the bottom of the PCBA).

If you are replacing the front bezel, proceed to the next section (*Replacing the Display or Touchscreen Assembly, Backlight Inverter, and Power Monitor Assemblies*) for removal of the remaining front bezel assembly components.

## Replacing the Display or Touchscreen Assembly, Backlight Inverter, and Power Monitor Assemblies

1 Remove the front bezel assembly as described in *Removing the Bezel Assembly* on page 4-10.

2 Remove the four screws securing the display assembly to the front bezel and carefully lift the assembly from the bezel.

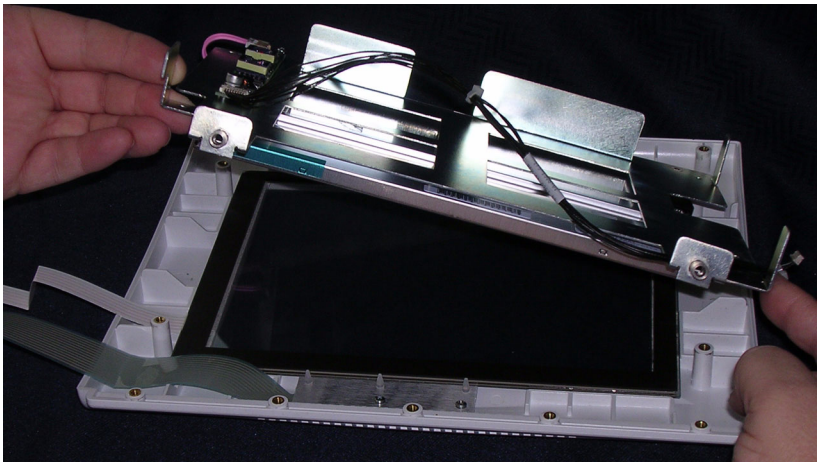


*Figure 4-6: Removing the touchscreen display bracket*

**Caution**

**The glass touchscreen may stick to the front of the display bracket. Do not allow it to fall off of the bracket during removal.**

3 Remove the four screws securing the display to the brackets.

***Note:***

*Be careful not to leave finger prints or smudges on the front of the display or on the inside of the front bezel surface.*

4 Reassemble the bezel assembly. Pay close attention to placement of the touchscreen, assuring that it is placed within the raised portion of the bezel prior to securing the display assembly. If alignment is not correct, the touchscreen can be permanently damaged.

*Figure 4-7: Touchscreen placement*

**5** To remove the backlight inverter, remove both cable assemblies and the two screws attaching the inverter to the display bracket.

**6** When replacing the backlight inverter, be sure to replace the mylar shield (*Figure 4-8*) between the PCBA and the chassis.

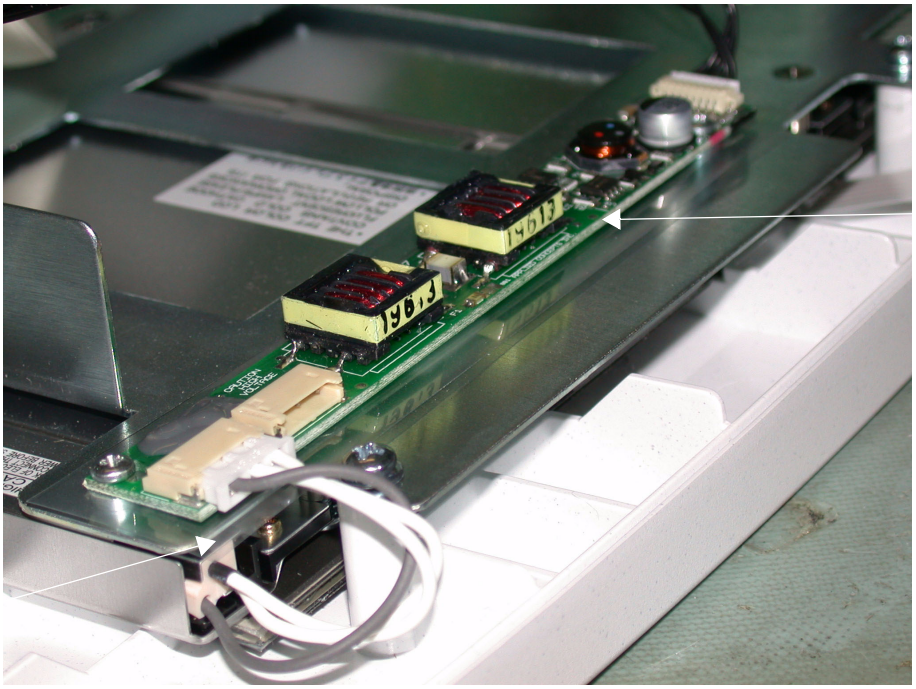



*Figure 4-8: Backlight inverter*

# Replacing the SDLC PCBA

## Removing the Rear Panel

1 Remove the five 6/32-inch x 1/2-inch screws.

*Figure 4-9: Rear panel replacement*

2 Remove the two 10/32-inch x 1/2-inch screws.

3 Carefully remove the rear panel and set it aside for further disassembly.

## Removing the SDLC PCBA

1 Remove the six 3/16-inch jack screws that secure the SDLC, video, and RS-232 connectors

2 Remove the two 6/32-inch x 1/4-inch screws that secure the SDLC PCBA to the rear panel.

3 Reinstall the replacement SDLC PCBA in reverse order.

## Replacing the CPU PCBA

1 Remove the batteries, if present.

2 Remove the bezel (refer to *Removing the Bezel Assembly* on page 4-10).

3 Remove the eight screws that hold the CPU PCBA to the chassis.

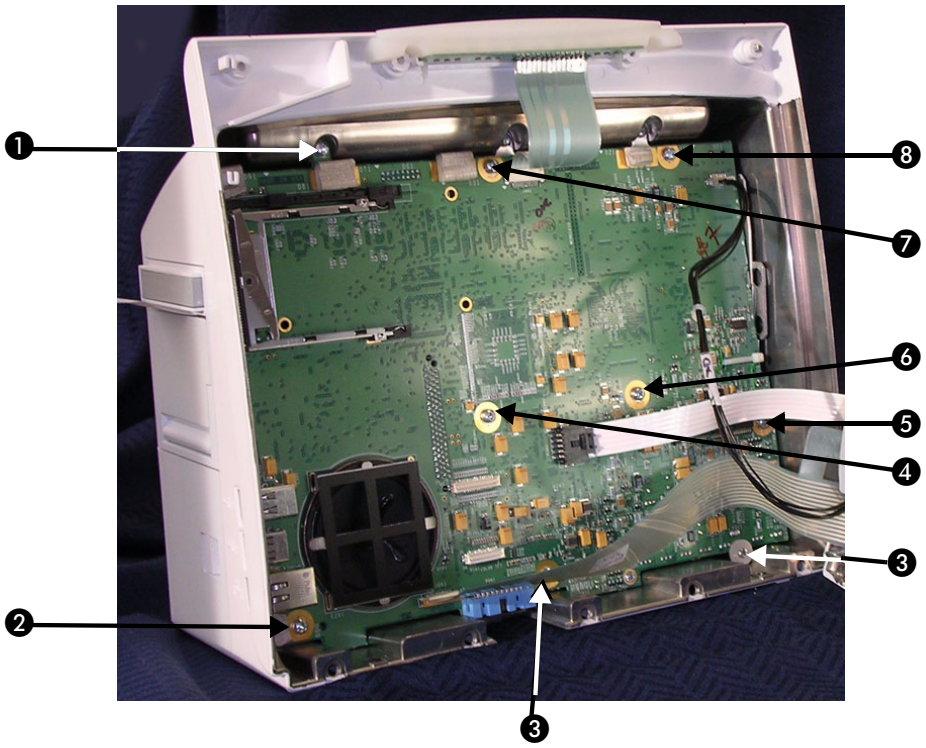



*Figure 4-10: Eight screws holding the CPU PCBA to the chassis*

4 Place your fingers into the space on either side of the upward protrusion of the CPU PCBA (located near the two top mounting screws) and pull. This will free the CPU PCBA-to-Interconnect PCBA connection.

5 Pull the CPU PCBA from the top carefully until the cables along the bottom of the assembly are visible.

6 Disconnect the three cables and set the CPU PCBA into a static-protected area.

7 Re-install the replacement CPU PCBA by following the above steps in reverse order.

## Removing the Chassis Assembly

The chassis assembly includes the sheet metal, Interconnect PCBA, and the fan/battery connection assembly.

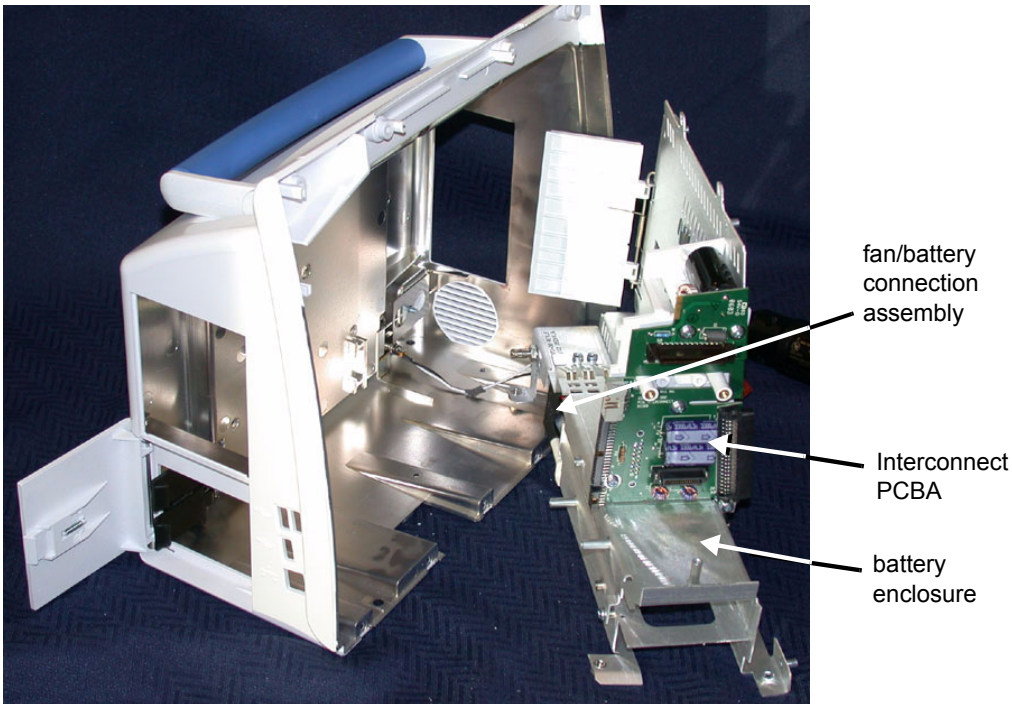



*Figure 4-11: Chassis assembly*

1. Remove the rear panel, bezel, CPU PCBA, module, and optional recorder and recorder CPU as previously described.
2. Place the monitor face down with the bottom facing you.
3. Remove the screw near the ground terminal area.
4. Remove the two screws with washers from the rear panel.

***Note:***

*These washers must be used when replacing the screws. If they are left out, the screws will penetrate into the battery chassis and interfere with the battery clearance.*

5. Remove the three 6/32-inch x 0.375-inch screws from the bottom of the monitor.
6. Turn the assembly over and remove the two top screws to secure the wall of the module compartment to the rear housing.
7. To lift the chassis out of the case, place your left hand through the battery door and your right hand into the module access opening. Work the assembly upward, allowing the top to move ahead of the bottom.
8. The chassis is now ready for further disassembly.

## Replacing the Fan/Battery Contact Assembly

1 Remove the chassis assembly from the housing as previously described.

2 Separate the chassis assembly from the module wall assembly by removing the two screws above the battery ejection springs and the two screws near the bottom.

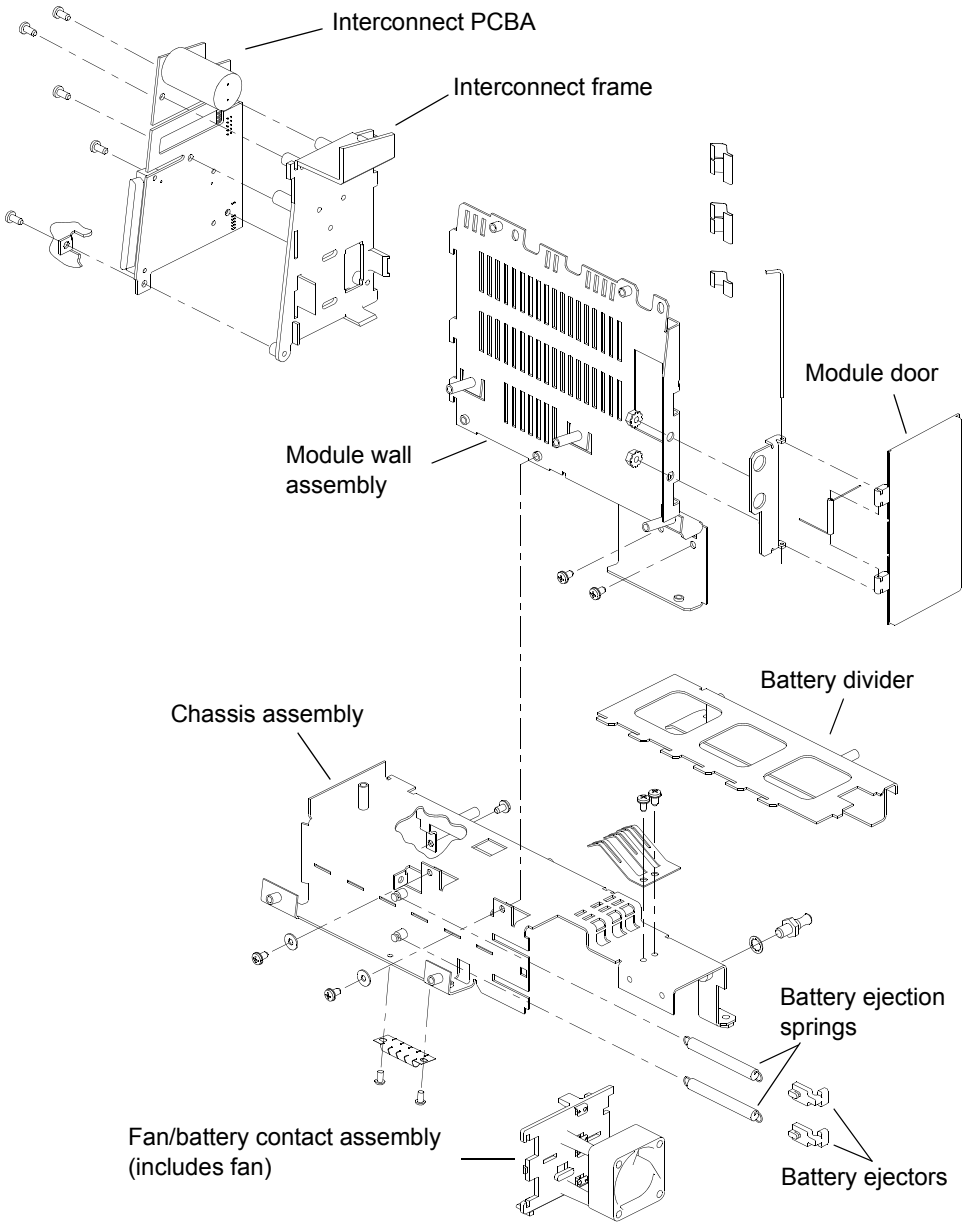



*Figure 4-12: Replacing the fan/battery contact assembly and Interconnect PCBA*

3 Pry up the center retainer on the battery contact assembly (near the battery ejection springs). This should free the fan/battery contact assembly.

4 Remove the screw between the chassis and the Interconnect PCBA.

## Replacing the Interconnect PCBA and Frame

1. Remove the chassis assembly from the housing as previously described.
2. Separate the chassis assembly from the module wall assembly by removing the two screws above the battery ejection springs and the two screws near the bottom.
3. Remove the screw between the chassis and the Interconnect PCBA.
4. Separate the Interconnect PCBA and frame.
5. Reassemble the monitor in reverse order.

## Replacing/Aligning the Module Door

1. To remove the door, remove the two nuts fastening the hinge to the wall of the module compartment assembly. This will free the door assembly. When installing a new door, do not tighten the two nuts until the chassis assembly is completely secured to the rear housing.
2. After the chassis and rear housing are mated, position the door and tighten the two nuts.

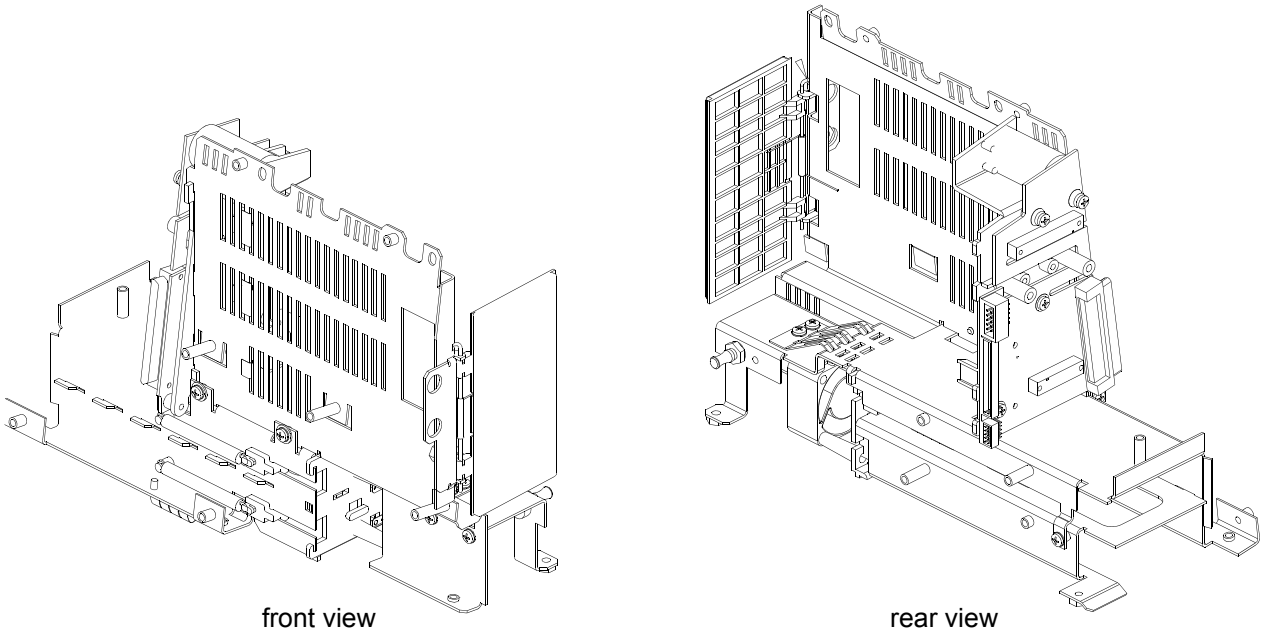



*Figure 4-13: Module door*

## Replacing the Embedded Nurse Alert Assembly

1. Remove the front bezel carefully.
2. Slide out the embedded nurse alert LED assembly.
3. Reverse the procedure to install the replacement.

# Cleaning

Clean the case by washing it with mild soap and water or use Plast-N-Glas cleaner. Use TF solvent for cleaning the electronic connectors and contacts as necessary.

***Note:***

*Avoid directly spraying liquids into the recorder openings.*

**Caution**

- **Do not autoclave.**
- **Never use solvents, acetone, abrasive cleaning agents, or abrasive cleaning pads.**
- **Use only approved cleaning agents including 70% alcohol, soap and water, green soap, or 10% bleach solution.**

# Troubleshooting

## Contents


Overview . . . . . 1
System Startup . . . . . 2
Boot Menu . . . . . 3
Power-ON Diagnostics . . . . . 5
Extended Diagnostics . . . . . 6
Diagnostic Menus . . . . . 7
Error Log . . . . . 10
Diagnostics Failure Messages and Error Codes . . . . . 11
System Troubleshooting . . . . . 13


## Overview

The first several sections describe the available diagnostics features and how to use them. This is followed by a section which lists diagnostics failure messages and the suggested corrective actions. The last section gives specific troubleshooting steps which can be used to isolate failures.

The troubleshooting procedures in this chapter isolate equipment problems to a Field Replaceable Unit (FRU).

The following items are field-replaceable:

- PCBA, Connector
- PCBA, Interconnect
- PCBA, CPU
- All sheet metal and plastic parts
- External DC power supply
- LCD display
- 5-wire resistive touchscreen
- Internal alarm LED assembly
- Power indicator flexboard
- Backlight inverter board

**Caution**

**Observe precautions for handling electrostatic-sensitive devices!**

***Note:***

- *Never touch electrostatic-sensitive electronic components without following proper anti-static procedures, including the use of an ESD wrist band and mat. An electrostatic discharge from your fingers can permanently damage electronic components and cause latent failures.*
- *All static-sensitive electronic components are packaged in static-shielding bags. Retain the bag for repackaging the component should you need to store it or return it to Spacelabs Medical for any reason.*

## Required Tools and Parts

The following items are necessary for troubleshooting:

- Anti-static mat with wrist strap
- #1 and #2 Phillips-head screwdriver
- 5/16-inch nut driver
- 3/16-inch nut driver
- Multimeter

## Problem Solving

Before starting the troubleshooting procedures, first establish that there is a fault by performing the monitor functional tests (refer to *Functional Tests* on page 4-5). Refer to the *Ultraview SL Operations Manual* (P/N 070-1150-xx) located on CD-ROM P/N 084-1101-xx, for specific information on operation.

# System Startup

When the monitor is first powered ON, the **System Startup** window appears.

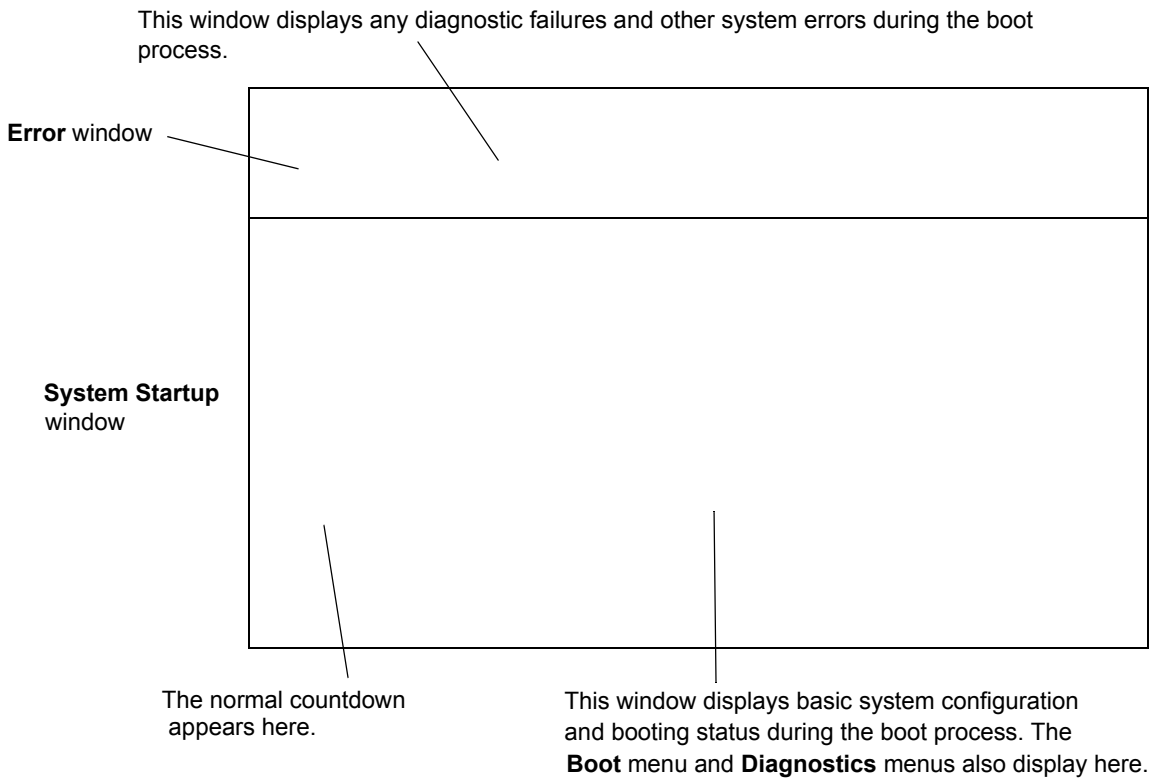

This window displays any diagnostic failures and other system errors during the boot process.
**Error** window
**System Startup** window
The normal countdown appears here.
This window displays basic system configuration and booting status during the boot process. The **Boot** menu and **Diagnostics** menus also display here.

*Figure 5-1: System Startup window*

When this screen is displayed, the monitor automatically begins power-ON diagnostics. Any diagnostics failures are reported in the upper window. If no serious diagnostics failures are encountered, the monitor continues past this screen and starts normal monitor operation.

During the countdown, the booting operation can be halted and a **Boot** menu of boot options can be displayed.

The **Boot** menu and the power-ON diagnostics are described in the sections that follow.

# Boot Menu

The **Boot** menu (*Figure 5-3* on page 5-4) is activated during system startup. It allows access to several basic configuration menus and functions of the monitor, including extended diagnostics. All text displayed on the screen is also output to the serial port.

To activate the **Boot** menu:

1. Turn ON the monitor and wait until it displays the countdown.
2. Before the countdown expires, perform the following step using either the touchscreen, mouse, keyboard, or terminal (or a computer with terminal emulation software) connected to the serial port:
   - **Touchscreen** — Touch the bottom left and then the bottom right corner (not simultaneously) of the screen (*Figure 5-2*).
   - **Mouse** — Click the left and right mouse buttons simultaneously.
   - **Keyboard or terminal** — Press CNTL+D (the terminal's serial port should be set to 9600 baud, no parity, 8 data bits, and one stop bit).

*Figure 5-2: Finger placement to initiate Boot menu using the touchscreen during the countdown.*

3 The **Boot** menu appears as shown in *Figure 5-3*.

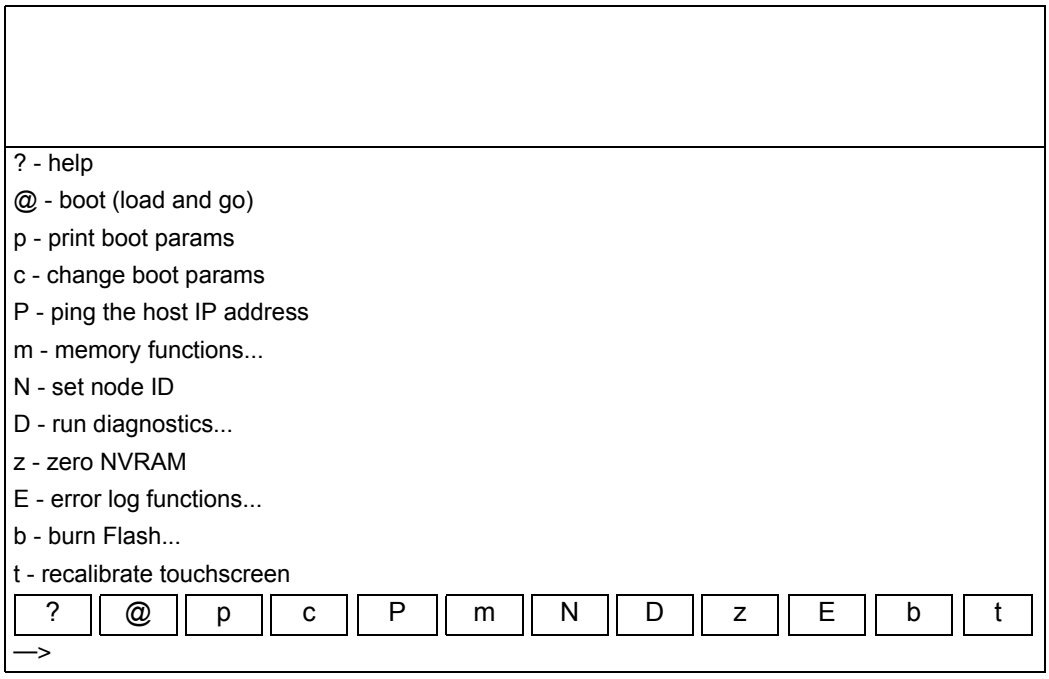

? - help
@ - boot (load and go)
p - print boot params
c - change boot params
P - ping the host IP address
m - memory functions...
N - set node ID
D - run diagnostics...
z - zero NVRAM
E - error log functions...
b - burn Flash...
t - recalibrate touchscreen
? @ p c P m N D z E b t
—>

*Figure 5-3: Boot menu*

## Caution

**Use caution when executing functions in this menu. The user should only execute Diagnostics (D) or use the Error Log (E). The rest of the features are only for qualified Spacelabs Medical field service engineers.**

***Note:***
*All menu selections are case-sensitive when using a keyboard or terminal.*

The following keys are available in the **Boot** menu:

**?** — Provides an explanation of this menu.

**@** — Starts the monitoring application.

**p** — Prints the boot parameters (*Figure 5-4* on page 5-5)

**c** — Allows boot parameters to be changed.

**P** — Allows this monitor to ping the host IP address [host inet (h)].

**m** — Requires a data key (Spacelabs field service engineers only). Displays the **Memory Menu** (*Figure 5-7* on page 5-9), which allows the display, modification, copying, and filling of any memory or address space accessible to the CPU.

**N** — Allows the node ID to be changed and sets the monitor ID number in Network Setup.

**D** — Displays the **Main Diagnostic Menu** (*Figure 5-5* on page 5-7).

**z** — Requires a data key (Spacelabs field service engineers only). Zeros and initializes the NVRAM.

**E** — Displays the **Error Log Functions Menu**, which allows the error log to be cleared or dumped to the screen and serial port.

**b** — Displays the **Burn Flash Menu**, which allows new boot kernel or application software to be loaded over the network and burned into flash memory (Spacelabs field service engineers only).

**t** — Recalibrates the touchscreen (monitor will reset).

## Boot Parameters

Touch the **p** key in the **Boot** menu to display the boot parameters. Touch **Continue** to return to the **Boot** menu.

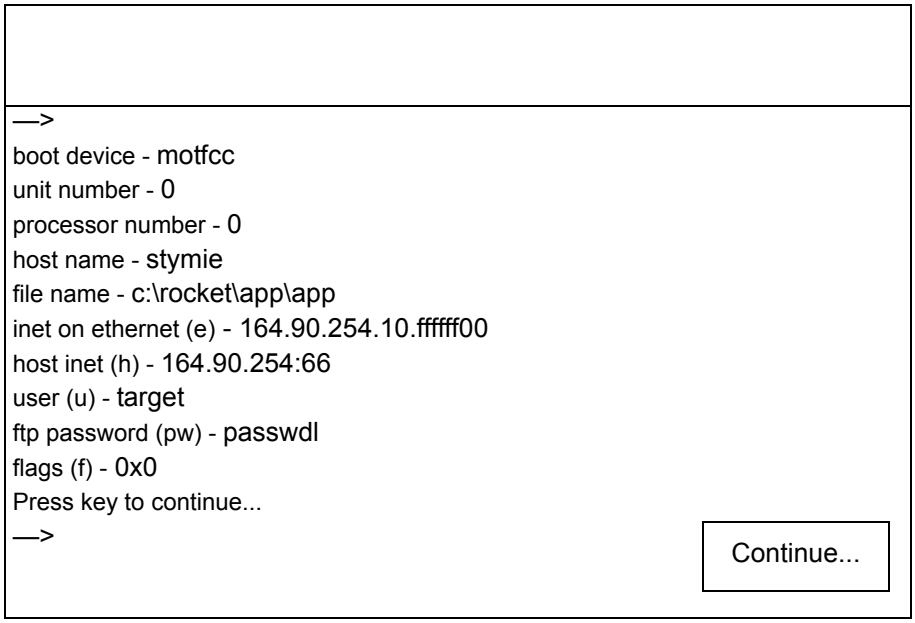



*Figure 5-4: Boot Parameters menu with default settings*

# Power-ON Diagnostics

Power-ON diagnostic tests verify system hardware integrity during power-up and can often help isolate and troubleshoot a problem. Most of these tests can also be initiated using the extended diagnostic mode. The diagnostics initiated at power-ON are:

- CPU (reads and writes control registers and does an internal wrap-around of one serial communication controller channel).
- DRAM read/write (reads and writes DRAM above 1 MB).
- Real-time clock (verifies that the clock is running).
- GDS SRAM (reads and writes all of the SRAM, nondestructively).
- PCI bridge (reads and writes control registers).
- ISA bridge (reads and writes control registers).
- Video (tests the video memory, video controller, Hsync, and blue video signals).

- Ethernet (reads and writes control registers).
- Flash checksum (checksums all flash memory).
- Touchscreen (tests the touchscreen controller).
- Audio (reads and writes control registers in the codec).

Power-ON diagnostic failures are reported in the upper portion of the **System Startup** screen. Refer to *System Startup* on page 5-2 for additional information.

Any error that occurs during one of these tests is logged in the non-volatile configuration memory. Refer to *Error Log* on page 5-10 to retrieve the log.

# Extended Diagnostics

Extended diagnostic tests, like the power-ON diagnostics, can be used to troubleshoot and isolate many system failures. The types of tests and features available in the extended diagnostics are:

- Power-ON diagnostics.
- Interactive tests and read/write memory tests that are not appropriate during power-ON diagnostics.
- Touchscreen calibration and data dump utilities.
- System data dump and system reset utilities.

The diagnostic menus allow most of these tests to be run individually or all at once. If Loop mode is activated, a test(s) can be executed in a continuous loop. If Halt On Error mode is activated, the looping stops when a diagnostic failure is detected. To avoid false failures, do not use the touchscreen, mouse, or keyboard while the diagnostic tests are executing.

Extended diagnostics failures are reported in the upper left corner of the **System Startup** screen. Refer to *System Startup* on page 5-2 for more information.

Any error that occurs during one of these tests is logged in the non-volatile memory. Refer to *Error Log* on page 5-10 to retrieve the log.

For detailed information on extended diagnostics and how to run them, refer to *Diagnostic Menus* below.

# Diagnostic Menus

## Main Diagnostic Menu

Touch the **D** key in the **Boot** menu to display the **Main Diagnostic Menu** (*Figure 5-5*).

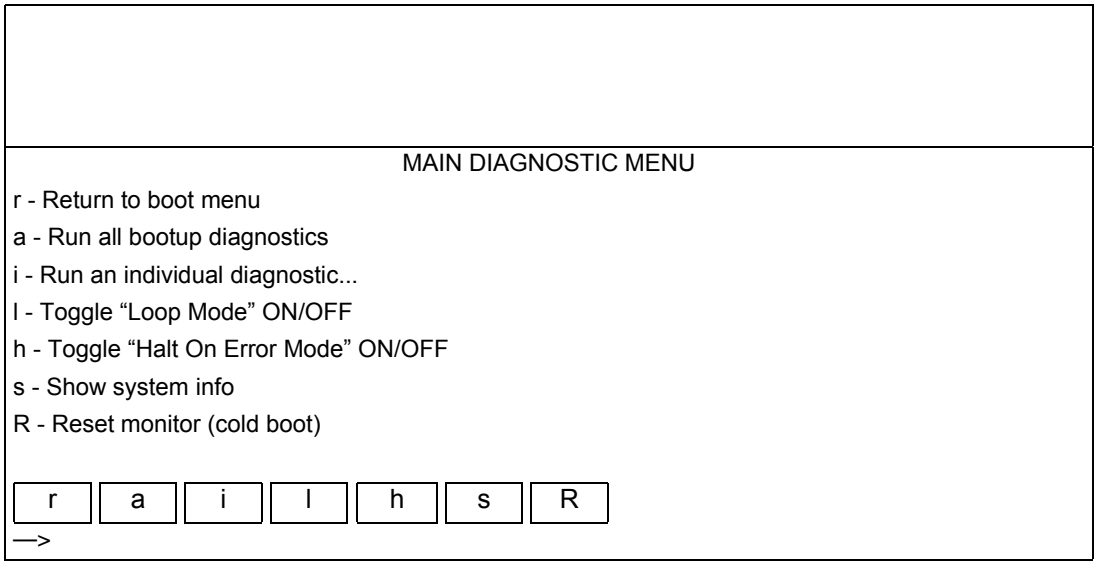



*Figure 5-5: Main Diagnostic Menu*

The following functions are available in the **Main Diagnostic Menu**:

**r** — Returns to the **Boot** menu.

**a** — Runs the same tests that are run during power-ON diagnostics.

**i** — Displays the **Individual Diagnostic Menu** (*Figure 5-6*).

**l** — Toggles Loop mode ON or OFF. When Loop mode is ON, any test or tests that are selected will run in a continuous loop until power is turned OFF.

**h** — Toggles Halt On Error mode ON or OFF. When ON, any failure that occurs while tests are running in Loop mode immediately stops testing.

**s** — Shows system information, including details of address spaces and variables used in the system.

**R** — Causes a cold boot reset just like turning the power OFF.

## Individual Diagnostic Menu

Touch the **i** key in the **Main Diagnostic Menu** to display the **Individual Diagnostic Menu**.

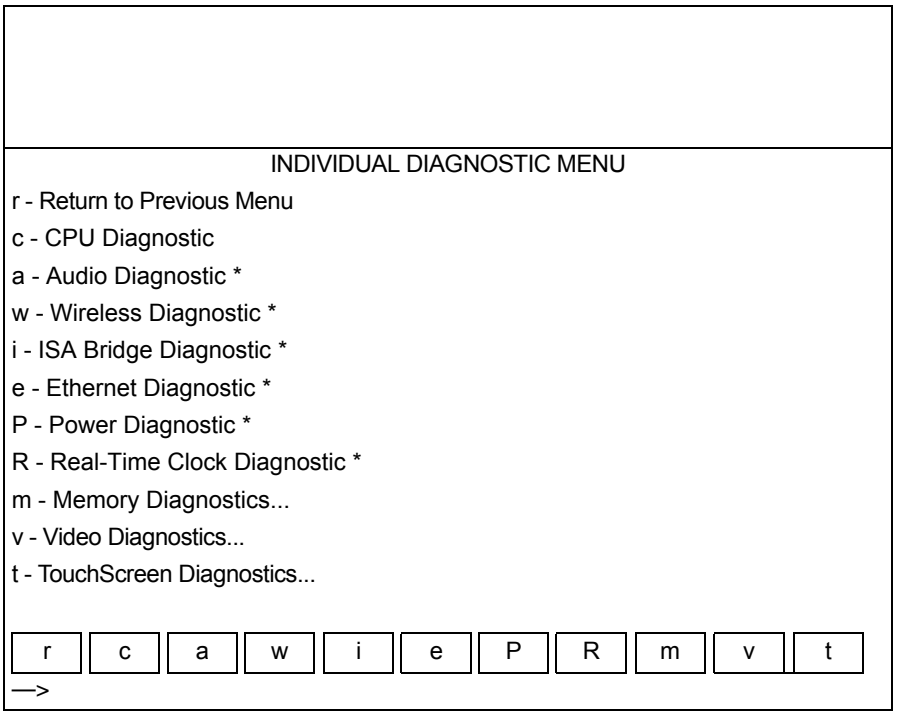

INDIVIDUAL DIAGNOSTIC MENU
r - Return to Previous Menu
c - CPU Diagnostic
a - Audio Diagnostic *
w - Wireless Diagnostic *
i - ISA Bridge Diagnostic *
e - Ethernet Diagnostic *
P - Power Diagnostic *
R - Real-Time Clock Diagnostic *
m - Memory Diagnostics...
v - Video Diagnostics...
t - TouchScreen Diagnostics...
r c a w i e P R m v t
—>

*Figure 5-6: Individual Diagnostic menu*

The following keys are available in the **Individual Diagnostic Menu**:

**r** — Returns to the **Main Diagnostic Menu**.

**c** — Tests certain CPU functions, similar, but not identical to, the power-ON CPU test.

**a** — Runs the power-ON audio diagnostic.

**w** — Runs the power-ON wireless LAN diagnostic (if installed).

**I** — Runs the power-ON ISA bridge test.

**e** — Runs the power-ON Ethernet test.

**P** — Runs the power-ON diagnostic test.

**R** — Ensures that the real-time clock is running.

**m** — Requires a data key (Spacelabs field service engineers only) for some functions. Displays the **Memory Menu** (*Figure 5-7*).

**v** — Displays the **Video Menu**.

**t** — Displays the **Touchscreen Menu**.

### Memory Menu

Touch the **m** key in the **Individual Diagnostic Menu** to display the **Memory Menu**.

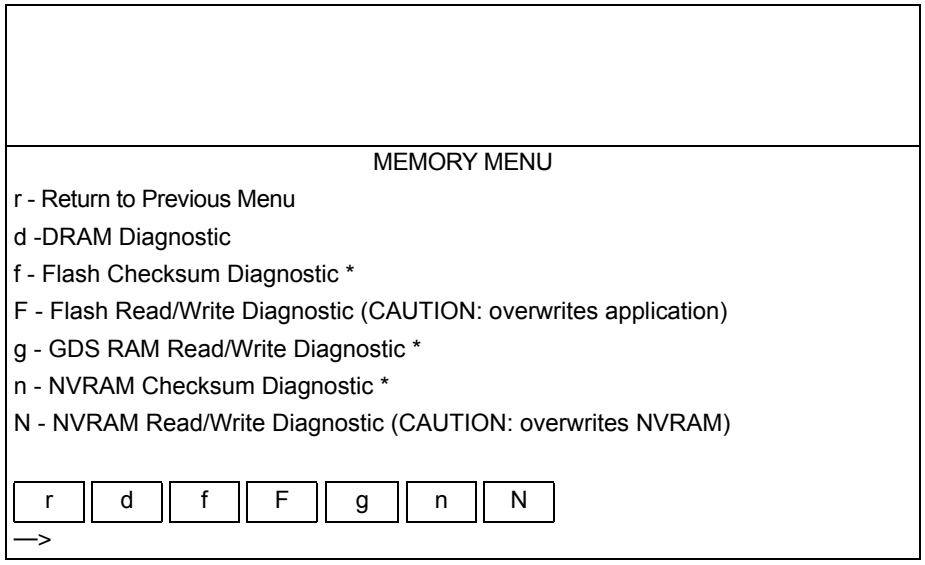



*Figure 5-7: Memory Menu*

The following keys are available in the **Memory Menu**:

**r** — Returns to the **Individual Diagnostics Menu**.

**d** — Runs a DRAM test, similar to the power-ON DRAM test, but tests only the memory not in use by the boot kernel.

**f** — Performs the power-ON flash checksum.

**F** — Performs a read/write test on the application area of flash memory, which overwrites the application software. Reload the software after the test. Requires a data key (Spacelabs field service engineers only).

**g** — Runs the power-ON GDS SRAM test.

**n** — Performs a checksum on NVRAM.

**N** — Performs a read/write test of NVRAM, which overwrites configuration parameters in NVRAM. After completing the NVRAM test, NVRAM should be zeroed and the boot parameters and sysgen values should be re-entered. Requires a data key (Spacelabs field service engineers only).

### Video Menu

Touch the **v** key in the **Individual Diagnostic Menu** to display the **Video Menu**.

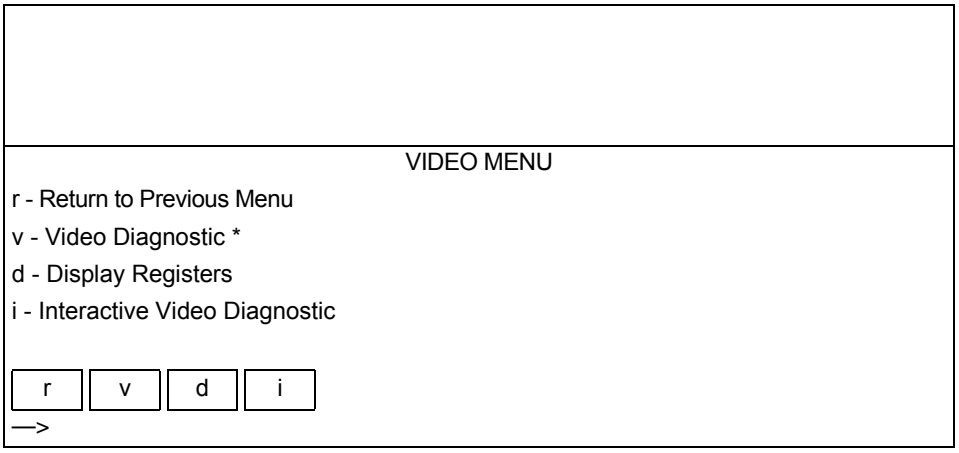



*Figure 5-8: Video Menu*

The following keys are available in the **Video Menu**:

**r** — Returns to the **Individual Diagnostics Menu**.

**v** — Runs the power-ON video diagnostic.

**d** — Displays the registers

**i** — Runs an interactive video diagnostic, which displays red, green, blue, white, and black screens, for five seconds each. Inspect the screen for faulty pixels.

# Error Log

For troubleshooting intermittent problems, the monitor maintains an error log for both recoverable and non-recoverable errors in its battery-backed, non-volatile memory. All diagnostics failures are logged in the error log.

Most errors relate to the CPU PCBA, but some errors may be caused by the parameter module or software errors. For example, a particular sequence of key strokes that always produces the same error code could be a software problem.

## Displaying the Error Log

Before using the error log, ensure that all other procedures have been followed, including elimination of operator errors, testing of voltages, correction of display faults, diagnostic testing, cabling/connector repairs, software compatibility, etc.

From the **Boot** menu (refer to *Boot Menu* on page 5-3), touch **E** to access the **Error Log Functions Menu**, then **d** to view the error log.

### Clearing the Error Log

Press **E**, then press **c** to clear the error codes automatically the next time the monitor application executes.

# Diagnostics Failure Messages and Error Codes

If the monitor fails power-ON diagnostics or extended diagnostics, do the following:

1. Verify the failure by powering the monitor OFF and ON again or by running the extended diagnostics as described in *Extended Diagnostics* on page 5-6 and *Diagnostic Menus* on page 5-7.
2. Take troubleshooting action or replace the field-replaceable units (FRU) based on the following diagnostics failure messages once the failure has been verified.

*Table 1: Diagnostic Failure Messages*

| Error Code | Diagnostics Failure Message | Suggested Action |
|---|---|---|
| 01030000 | *Diagnostics passed* | No action required. |
| 01030001 | *Diagnostic(s) failed; degraded performance* | Replace CPU PCBA. |
| 01030002 | *Critical failure* | Replace CPU PCBA. |
| 01030003 | *Cannot diagnose at this boot stage* | No information available. |
| 01030100 | *Diagnostics Port test failed* | Replace CPU PCBA. |
| 01030200 | *8260 test failed* | Replace CPU PCBA. |
| 01030201 | *8260 SCC transmit failed* | Replace CPU PCBA. |
| 01030202 | *8260 SCC configuration not recognized* | Replace CPU PCBA. |
| 01030300 | *DRAM test failed* | Replace CPU PCBA. |
| 01030301 | *DRAM test cannot allocate memory* | Reboot and retest. If problem persists, replace CPU PCBA. |
| 01030400 | *GDS RAM test failed* | Replace CPU PCBA. |
| 01030500 | *FLASH ROM test failed* | Replace CPU PCBA. |
| 01030501 | *FLASH ROM boot larger than Flash* | Reburn boot kernel software into flash memory and retest. If failure persists, replace CPU PCBA. |
| 01030502 | *FLASH ROM app larger than Flash* | Reburn application software into flash memory and retest. If failure persists, replace CPU PCBA. |
| 01030503 | *FLASH ROM boot checksum error* | Reburn boot kernel software into flash memory and retest. If failure persists, replace CPU PCBA. |
| 01030504 | *FLASH ROM app checksum error* | Reburn application software into flash memory and retest. If failure persists, replace CPU PCBA. |

*Table 1: Diagnostic Failure Messages (continued)*

| Error Code | Diagnostics Failure Message | Suggested Action |
|---|---|---|
| 01030505 | *FLASH ROM read/write memory test error* | Replace CPU PCBA. |
| 01030600 | *Power Subsystem test failed* | Replace CPU PCBA. |
| 01030601 | *A2D Converter failed to convert* | Replace CPU PCBA. |
| 01030602 | *Invalid power request* | Replace CPU PCBA. |
| 01030603 | *Temperature out of spec* | Replace CPU PCBA. |
| 01030700 | *PCI Bridge test failed* | Replace CPU PCBA. |
| 01030701 | *PCI Bridge configuration not recognized* | Replace CPU PCBA. |
| 01030702 | *PCI Bridge registers are not writable* | Replace CPU PCBA. |
| 01030703 | *PCI Bridge revision not valid for clinical use* | Replace CPU PCBA. |
| 01030800 | *Ethernet test failed* | Replace CPU PCBA. |
| 01030801 | *Ethernet setup failed* | Replace CPU PCBA. |
| 01030802 | *Ethernet transmit failed* | Replace CPU PCBA. |
| 01030900 | *ISA Bridge test failed* | Replace CPU PCBA. |
| 01030A00 | *Video test failed* | Replace CPU PCBA. |
| 01030A01 | *Invalid display type* | Replace CPU PCBA. |
| 01030A02 | *Invalid display size* | Replace CPU PCBA. |
| 01030A03 | *Video configuration not recognized* | Replace CPU PCBA. |
| 01030A04 | *Video DRAM failure* | Replace CPU PCBA. |
| 01030A05 | *Video could not detect hsync signal* | Replace CPU PCBA. |
| 01030A06 | *Video could not detect blue video signal* | Replace CPU PCBA. |
| 01030C00 | *OS error while diagnosing KBD* | Reboot and retest. If problem persists, replace CPU PCBA. |
| 01030C01 | *Cannot access KBD device registers* | Replace CPU PCBA. |
| 01030C02 | *KBD did not respond to command* | Replace CPU PCBA. |
| 01030C03 | *KBD failed selftest* | Replace CPU PCBA. |
| 01030C04 | *KBD failed interface test* | Replace CPU PCBA. |
| 01030D00 | *Cannot access AUDIO device registers* | Replace CPU PCBA. |
| 01030D01 | *Could not open audio device* | Reboot and retest. If problem persists, replace CPU PCBA. |
| 01030D02 | *Audio device did not respond correctly* | Replace CPU PCBA. |
| 01030D03 | *Audio Loopback test failed* | Replace CPU PCBA. |
| 01030E00 | *NVRAM test failed* | Replace CPU PCBA. |
| 01030E01 | *NVRAM clock not running* | Replace CPU PCBA. |

*Table 1: Diagnostic Failure Messages (continued)*

| Error Code | Diagnostics Failure Message | Suggested Action |
|---|---|---|
| 01030E02 | *NVRAM checksum error* | Zero the NVRAM and reboot. Re-program all items in the **Biomed**, **CSR**, and **Clinical** menus (Spacelabs field service engineers only). If problem persists, replace CPU PCBA. |
| 01030E03 | *NVRAM read/write memory test failed* | Replace CPU PCBA. |

# System Troubleshooting

This section describes troubleshooting procedures which can be used in conjunction with, or separately from, the diagnostics to isolate a failure.

## Required Tools/Test Equipment

#1 Phillips screwdriver

## Display

### Garbled Display, No Display, or Touchscreen Response

1. Ensure that the external DC power supply is properly connected (power LED to the right of the power ON/OFF switch is illuminated). If the light is OFF, troubleshoot the external power supply.
2. Cycle the power ON/OFF switch several times and verify that the graphic on the power switch illuminates. If no light is evident, the +5 V power supply on the CPU is not present and will require troubleshooting.
3. Remove the plug-in patient parameter module. Cycle the power ON/OFF switch to verify that the graphic on the power switch illuminates. If it does not illuminate, sequentially remove each of the following assemblies, cycle the power, and check for a tone before removing the next assembly.
   - Optional recorder assembly and its CPU PCBA.
   - The I/O PCBA.

   If the power switch illuminates after removing one of these assemblies, repair or replace that assembly. If the power switch still does not illuminate, go to step 4.

**Caution**

- **Partial disassembly may be required for troubleshooting. Ensure that the external power supply and rechargeable battery(ies) are disconnected. When disassembling the monitor, use a nonconductive, anti-static material to insulate the CPU PCBA from the front bezel assembly (a piece of cardboard will suffice).**
- **The ends of the cables that connect the front bezel of the CPU PCBA to the display must be handled with care. When disconnecting this cable, the latch should be gently lifted using finger pressure. A broken latch may still lock the cable into the connector, but it will not provide guidance for centering the cable into the connector.**

4 Remove the front bezel assembly. Once the CPU PCBA is accessible, check the cable connections between it and the display and verify that the backlight is visible.

If the entire display is garbled or distorted:

- Check the cables and connectors interfacing the display to the CPU PCBA. A patient parameter module may need to be installed to view the top half of the display. If the connections are okay, replace first the CPU PCBA, then the display screen.

**Caution**

**Do not attempt to troubleshoot the display backlight electronics. There are very HIGH AC voltages in this area. Only qualified Spacelabs Medical field service engineers should attempt to troubleshoot this section.**

## Monitor Fails Power-ON Diagnostics

### Troubleshooting Method 1: Using the Touchscreen or Mouse

1 Display the **Main Diagnostic Menu**.

This menu is activated using the touchscreen or mouse. Press the left and right mouse buttons simultaneously, or touch the lower left and then the lower right corners, one at a time, during the “4, 3, 2, 1” countdown.

2 Click (or touch) the test parameter key that retests the previously indicated failure.

Upon verification of the failure, a message provided by the monitor directs you to the field-replaceable unit that failed.

### Troubleshooting Method 2: Using the Remote Terminal

1 Attach a remote terminal (9600 baud, no parity, 8 bits, 1 stop bit) to the serial connector.

2 Power ON the monitor.

3 Activate the **Serial Diagnostic** menu by pressing CTRL D during the “4, 3, 2, 1” countdown at system startup.

4 All power-ON tests can be performed to isolate the problem to a PCBA. The monitor will guide you to the appropriate field replaceable unit.

## Touchscreen

If the display is present but the touchscreen is unresponsive:

1. Calibrate the touchscreen (refer to *Diagnostic Menus* on page 5-7) using the mouse or keyboard. Check the operation again.
2. Run the Interactive Touchscreen test (refer to *Diagnostic Menus* on page 5-7).
3. Remove the external power supply and battery(ies) and check the connections interfacing the touchscreen to the CPU PCBA. If the connections are okay, replace the CPU PCBA.

## Module Slot

1. Verify the module's operation on another monitor (if available).
2. Check the software versions of all installed modules, Flexport interfaces, and other SDLC equipment attached, verifying with Spacelabs Medical that there are no incompatibilities.
3. Inspect the Interconnect PCBA. If any connectors or parts appear damaged, replace the damaged assembly.
4. If the problem persists, replace the CPU PCBA and the Interconnect PCBA, in that order.

## SDLC Output

1. If a module housing is present, verify that the proper SDLC terminations are set and that the proper cables are being used (refer to *Setup* on page 2-1 for more information).
2. Check the software versions of all installed modules, Flexport interfaces, and other SDLC equipment attached, verifying with Spacelabs Medical that there are no incompatibilities.
3. Inspect the I/O (Connector) PCBA and the Interconnect PCBA. If any connectors or parts on either of these assemblies appear damaged, replace the damaged assembly.
4. If the problem persists, replace the CPU PCBA.

## Ethernet

1. Check the network setup and verify that the correct monitor ID, monitor name, and subnet were entered.
2. If any changes are made in step 1, power OFF, then power ON for the changes to take effect.
3. Check for the green LED on the network connector showing a "LINK." Verify that the green LED is flashing about once every five seconds or faster, indicating network activity. The yellow LED will be ON when connected to a 100BaseT network and OFF when connected to a 10BaseT network.
4. Check the Ethernet cable for correct termination, and ensure that it is attached to a hub that is ON and functional. Use another Ethernet cable and test with a different monitor to verify the hub port is functional.
5. Replace the switch or hub.
6. If the problem persists, replace the CPU PCBA.

## Alarm Relay

1. Verify the operation of the external alarm device. Replace if it does not work correctly.
2. Verify that the alarm cable is installed correctly and that pin 9 on the connector has +12 V.
3. Inspect the I/O PCBA and the Interconnect PCBA if the problem persists. If any connectors or parts on either of these assemblies appear damaged, replace the damaged assembly.
4. If the problem persists, replace the CPU PCBA.

## External Display

1. Check the external display's power and video cables for proper connections. Verify that the display assembly is set in the correct operating mode.
2. Verify that the external display's brightness, vertical, and horizontal sync are set correctly.
3. Verify that the external display's terminations are set for 75 ohms, if settable.
4. Run the video diagnostic (refer to *Diagnostic Menus* on page 5-7). If it fails, replace the CPU PCBA.
5. Inspect the Interconnect PCBA and I/O PCBA. If any connectors or parts on either of these assemblies appear damaged, replace the damaged assembly.

## Keyboard, Mouse, or Barcode Scanner

1. Try another USB mouse or keyboard (there is no setup for the mouse or keyboard, either externally or internally). Cycle the power OFF and ON after changing the keyboard or mouse to guarantee that they are seen by the monitor.
2. Run the keyboard/mouse diagnostic (refer to *Diagnostic Menus* on page 5-7). If it fails, replace the CPU PCBA.
3. Check the USB connector for damage and replace the damaged assembly if necessary.
4. Ensure the barcode scanner is set for keyboard entry mode.

## Battery

The monitor can assist in troubleshooting failed batteries in several ways. It can detect gross failures such as shorted and weak batteries and batteries that cannot hold a charge. It cannot detect all battery failure modes. To debug a problem battery, run the following tests.

### Battery Charging Test

1. Install one or two suspect batteries.
2. Power the monitor from the AC power supply and switch the monitor OFF. The front panel battery LED(s) will be ON or blinking.
3. Let the batteries cycle through a complete charge. For batteries that are initially charged, wait at least one hour and 40 minutes. For batteries that are initially uncharged, wait at least three hours.

4 Check the front panel battery LED(s). If a faulty battery is detected, the front panel LED(s) blinks ON and OFF at a rate of 500 ms.

5 Replace the bad battery or batteries.

### Battery Fuel Gauge

When the monitor is powered by batteries only, with one or two batteries installed, a battery fuel gauge is displayed in the lower right corner of the screen. This gauge is useful in detecting bad batteries or other voltage problems in the system. After five minutes of operation on only one fully charged battery, if the battery fuel gauge reads 3/4 full or less, the battery may be faulty.

## Battery Charger

To verify that a faulty charger exists on the CPU PCBA, do the following.

1 Install a known good, fully discharged battery.

2 Power the monitor from the AC power supply and switch the monitor OFF. If the front panel battery LED does not blink, replace the CPU PCBA.

3 Let the battery cycle through a complete charge (90-120 minutes with monitor OFF).

***Note:***
*The indicated time is for NiMH batteries only.*

4 Check the front panel battery LED. It should be ON and not blinking. If not, replace the CPU PCBA. (Also, if the LED blinks for more than an hour, the charger is likely faulty).

## Recorder

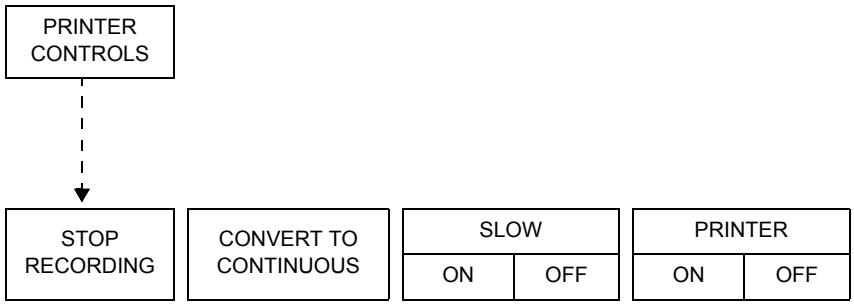



*Figure 5-9: Printer Controls menu*

The optional recorder downloads the printer control keys after it signs onto the SDLC bus. All of the printer control keys are initially inactive. The PRINTER ON/OFF key becomes active only if the recorder signs onto the SDLC bus with both an alive packet and on-line packet. If there is some failure in this process, the PRINTER ON/OFF key remains inactive. If this key is active and later becomes inactive, then a failure has deleted the recorder module from the SDLC bus.

At power-ON, LED D2 on the recorder CPU PCBA (located under the recorder assembly) will be ON. As the recorder executes its diagnostics, the LED will turn ON and OFF with successive tests. If all diagnostics pass, the recorder will sign on to the SDLC link with the LED OFF. If a diagnostic error occurs, the LED is left ON or flashing.

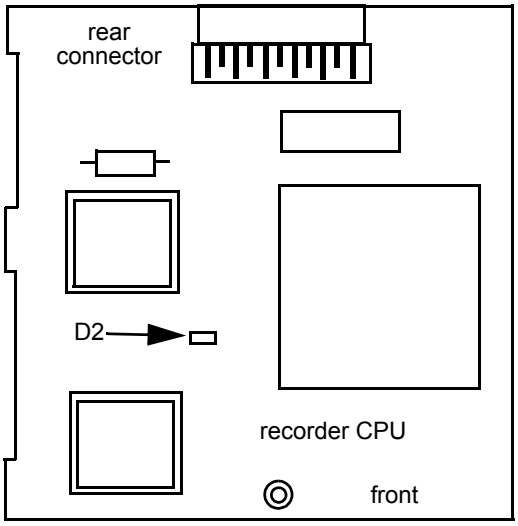



*Figure 5-10: Location of D2 on recorder CPU*

If a diagnostic error occurs, the recorder will attempt to print a diagnostic line instead of its usual sign-on message. This line is a series of hex numbers. Non-zero numbers represent error codes.

If the recorder is recognized by the monitor at power ON, a PRINTER CONTROLS key is present.

### Recorder Tips

If the PRINTER CONTROLS key is not displayed on the monitor:

1. Unplug the external power supply and remove any batteries.
2. Remove the recorder assembly by opening the paper door and loosening the two captive screws.
3. Remove the recorder CPU by loosening the thumb screw that fastens it to the chassis, pulling it outward, and lifting it out.
4. Re-install the recorder CPU by firmly inserting it into the connector. Occasionally when installing a recorder CPU, a second effort proves that the connection was not fully seated. Tighten the thumb screw.
5. Re-install the recorder assembly. Reinstall the batteries, connect the external power supply and turn the monitor ON. If the recorder door is closed and paper is properly loaded, the recorder CPU initiates a self-test. If the test is successful, a line of 1/4-inch bars will print on the paper followed by the recorder's model number, software version, and software date.
6. If the self-test fails, open the recorder door and remove the paper.
   - If the diagnostics detected a software failure on the recorder CPU, LED D2 will be steadily ON.
   - If the diagnostics detected a hardware failure in the recorder assembly, LED D2 will be continuously flashing ON and OFF.
   - If no failures were detected, LED D2 will be OFF.
7. If the recorder and the associated interface circuitry is good, an error report line is printed upon detection of an error.

During normal operation, D2 will be dimly lit (it is actually flashing very rapidly). LED Error Codes are shown in *Table 2*.

*Table 2: Recorder Error Codes*

| Error Code (hex) | Failed Assembly or Likely Cause |
|---|---|
| 80 | *EPROM checksum bad* |
| 8F | *Stack pointer bad* |
| 81 | *Internal RAM will not write all zeroes* |
| 82 | *Internal RAM will not write all ones* |
| 83 | *Timer 0 - No overflow* |
| 84 | *Timer 0 - High byte bad* |
| 85 | *Timer 0 - Low byte bad* |
| 86 | *Timer 1 - No overflow* |
| 87 | *Timer 1 - High byte bad* |
| 88 | *Timer 1 - Low byte bad* |
| 30 | *SDLC Errors - Bad Xmit status* |
| 31 | *SDLC Errors - No SI* |
| 32 | *SDLC Errors - No start flag* |
| 33 | *SDLC Errors - Bad address* |
| 34 | *SDLC Errors - Bad frame type* |
| 35 | *SDLC Errors - No end flag* |
| 10 | *Stuck I/O bus bit 0 low* |
| 11 | *Stuck I/O bus bit 1 low* |
| 12 | *Stuck I/O bus bit 2 low* |
| 13 | *Stuck I/O bus bit 3 low* |
| 14 | *Stuck I/O bus bit 4 low* |
| 15 | *Stuck I/O bus bit 5 low* |
| 16 | *Stuck I/O bus bit 6 low* |
| 17 | *Stuck I/O bus bit 7 low* |
| 18 | *Stuck I/O bus bit 0 high* |
| 19 | *Stuck I/O bus bit 1 high* |
| 1A | *Stuck I/O bus bit 2 high* |
| 1B | *Stuck I/O bus bit 3 high* |
| 1C | *Stuck I/O bus bit 4 high* |
| 1D | *Stuck I/O bus bit 5 high* |

*Table 2: Recorder Error Codes (continued)*

| Error Code (hex) | Failed Assembly or Likely Cause |
|---|---|
| 1E | *Stuck I/O bus bit 6 high* |
| 1F | *Stuck I/O bus bit 7 high* |
| 50 | *External RAM - Stuck bit - Bank 0* |
| 51 | *External RAM - Stuck bit - Bank 1* |
| 52 | *External RAM - Stuck bit - Bank 2* |
| 53 | *External RAM - Stuck bit - Bank 3* |
| 58 | *3-Par RAM test error - Bank 0* |
| 59 | *3-Par RAM test error - Bank 1* |
| 5A | *3-Par RAM test error - Bank 2* |
| 5B | *3-Par RAM test error - Bank 3* |
| 22 | *Front Panel key input error* |
| 23 | *EEPROM Tests - Checksum bad - No diagnostic jumper* |
| 25 | *EEPROM Tests - Error during checksum write* |
| 26 | *EEPROM Tests - New checksum no good* |
| 38 | *Printer Tests - WRRDY inactive or -SYNC active after reset* |
| 39 | *Printer Tests - Readback system wrong state after reset* |
| 3A | *Printer Tests - Error active after reset* |
| 3B | *Printer Tests - +BUSY not active after idle CMD* |
| 3C | *Printer Tests - +BUSY not inactive after idle CMD* |
| 3D | *Printer Tests - Error not active after illegal CMD* |
| 3E | *Printer Tests - Error not inactive after idle CMD* |
| 3F | *Printer Tests - +BUSY not inactive after idle CMD* |
| 40 | *Printer Tests - Incorrect feedback after illegal CMD* |
| 41 | *Thermal array over-temperature* |
| 42 | *Low 12V supply to AR42 recorder* |
| 43 | *High 12V supply* |
| 44 | *Other AR42 error* |
| 27 | *Error detected during print test* |
| 2A | *SDLC cable not present* |
| 2B | *SDLC clock frequency too high* |
| 2C | *SDLC clock frequency too slow* |
| 2E | *Watchdog timeout too short* |

*Table 2: Recorder Error Codes (continued)*

| Error Code (hex) | Failed Assembly or Likely Cause |
|---|---|
| 2F | *Watchdog timeout too long* |
| D1 | *Stack error* |
| 67 | *Printer error code - Printer did not like command sent* |
| 60 | *Manual re-init seen* |
| 69 | *Printer error during initialization* |
| C0 | *Unload state error - Invalid state* |
| A1 | *Already printing when another print command received* |

# Contents

Overview . . . . . 1
Parts List . . . . . 1
Assembly Drawings and Schematics. . . . . 4

# Overview

This chapter presents exploded views of monitor assembly and PCBA schematics for the monitor.

**Caution**

**Observe precautions for handling electrostatic-sensitive devices!**

***Note:***

- *Never touch electrostatic-sensitive electronic components without following proper anti-static procedures, including the use of an ESD wrist band and mat. An electrostatic discharge from your fingers can permanently damage electronic components and cause latent failures.*
- *All static-sensitive electronic components are packaged in static-shielding bags. Retain the bag for repackaging the component should you need to store it or return it to Spacelabs Medical for any reason.*

# Parts List

## Field-Replaceable Parts

*Table 1: Field Replaceable Parts*

| Description | Part Number |
|---|---|
| PCBA, CPU, 91369 | 670-1275-00 |
| PCBA, Interconnect, 91369 | 670-0849-03 |
| Assembly, I/O Bay, SDLC, Alm, Eth, Com, 91369 | 670-1302-00 |
| Assembly, Nurse Alert | 650-1425-00 |
| Assembly, 91369, Power Monitor Switch | 650-1429-00 |
| Touchscreen, 5-Wire Resistive, 10.4 in. | 010-1445-00 |
| Display, LCD, Color, TFT, 640 x 480, NEC | 150-0340-00 |
| Inverter, Backlight, CCFL, Dual Tube App. | 010-1603-00 |
| Backlight, NEC, Replacement Kit | 050-0353-00 |
| Power Supply | 119-0479-00 |
| Battery, NiMH, 12 V, 2.45 AH | 146-0055-00 |

*Table 1: Field Replaceable Parts (continued)*

| Description | Part Number |
|---|---|
| PCBA, Recorder CPU, 91369 | 670-0624-05 |
| Service Kit, Recorder | 050-0064-01 |
| Fan Assembly, 40 mm, 12 V | 119-0186-01 |
| Plug, Recorder | 134-0032-02 |
| Internal, Chassis, 91369 | 441-0073-01 |
| Frame, Contact Assembly with Fan | 650-0279-01 |
| Bezel, Front | 203-0231-00 |
| Panel, Rear, 91369 | 333-0887-00 |
| Retainer, Handle, 91369 | 343-0372-00 |
| Handle, Enclosure, 91369 | 367-0833-00 |
| Frame, Interconnect | 426-0039-04 |
| Frame, Contact, 91369 | 426-0041-01 |
| Enclosure, Rear, 91369 | 437-5045-00 |
| Plug, Hole, SDLC Port, 91369 | 134-0044-01 |
| Latch, Battery | 105-0038-01 |
| Door, Battery | 202-0228-00 |
| Spring, Battery Door | 214-0328-00 |
| Pin, Hinge, Battery Door | 214-0318-00 |
| Ejector, Battery | 214-0317-01 |
| Spring, Extension | 214-0333-01 |

## Cables and Adapters

*Table 2: Cables and Adapters*

| Description | Part Number |
|---|---|
| Cable, Serial I/O (RS-232) | 012-0182-02 |
| Cable, Video, Male DB15HD to Male DB15HD | 012-0593-00 |
| Cable, Monitor to Module Housing, 2 ft (0.61 m) | 012-0532-02 |
| Cable, Monitor to Module Housing, 4 ft (1.22 m) | 012-0532-04 |
| Cable, Monitor to Module Housing, 8 ft (2.44 m) | 012-0532-08 |
| Cable, Monitor to Module Housing, 10 ft (3.05 m) | 012-0532-10 |
| Cable, Assembly, Ethernet, 10/100BaseT, 3 ft (0.94 m) | 175-0951-00 |
| Cable, Assembly, Ethernet, 10/100BaseT, 6 ft (1.8 m) | 175-0951-01 |
| Cable, Assembly, Ethernet, 10/100BaseT, 12 ft (3.7 m) | 175-0951-02 |
| Cable, Assembly, Ethernet, 10/100BaseT, 20 ft (6.1 m) | 175-0951-03 |

## Field-Replaceable Mounting Hardware Parts

*Table 3: Mounting Hardware Replaceable Parts*

| Description | Part Number |
|---|---|
| Bed Rail Mount, 91369 | 016-0369-00 |
| Power Supply Mount, Universal | 016-0732-00 |

## Miscellaneous Parts

*Table 4: Miscellaneous Parts*

| Assembly | Description | Part Number |
|---|---|---|
| Keyboard/Mouse Combo | USB, U.S., Wireless, w/Mouse | 010-1620-00 |
| Keyboard | USB, English | 010-1621-00 |
| Mouse | USB, Mouse, Optical | 010-1622-00 |

# Assembly Drawings and Schematics

The following assembly drawings and schematics are included as part of this manual.

*Table 5: Assembly Drawings and Schematics*

| Title | Drawing P/N | Drawing Number |
|---|---|---|
| Monitor Assembly | N/A | 1 (7 sheets) |
| Schematics, PCBA, CPU | 676-0684-00 | 2 (43 sheets) |
| Schematics, PCBA, I/O | 676-0705-00 | 3 (3 sheets) |
| Schematics, PCBA, Interconnect | 676-0148-02 | 4 (3 sheets) |
| Schematics, PCBA, CPU, Recorder | 676-0012-00 | 5 (4 sheets) |
| System Block Diagram | N/A | 6 (1 sheet) |

## BIOMED Directory of Keys

The **Biomed Level** menu displays when the operator enters the Biomed password into the **Privileged Access** window. An alternative means of displaying this menu is to enter either the CSR or SL passwords and then select the BIOMED MENU key.

**MONITOR SETUP**

PRIVILEGED ACCESS

*Enter Biomed password and touch ENTER*

**BIOMED LEVEL**

| NETWORK SETUP | SERIAL PORT | MONITOR CALIBRATION | CHANGE BIOMED PASSWORD | CLINICAL MENU | MORE |
|---|---|---|---|---|---|
| *Refer to Setup chapter* | | *Refer to Setup chapter* | *Refer to Setup chapter* | *Refer to page 7-3* | *Refer to page 7-2* |

**Select serial port to assign owner to:**

1

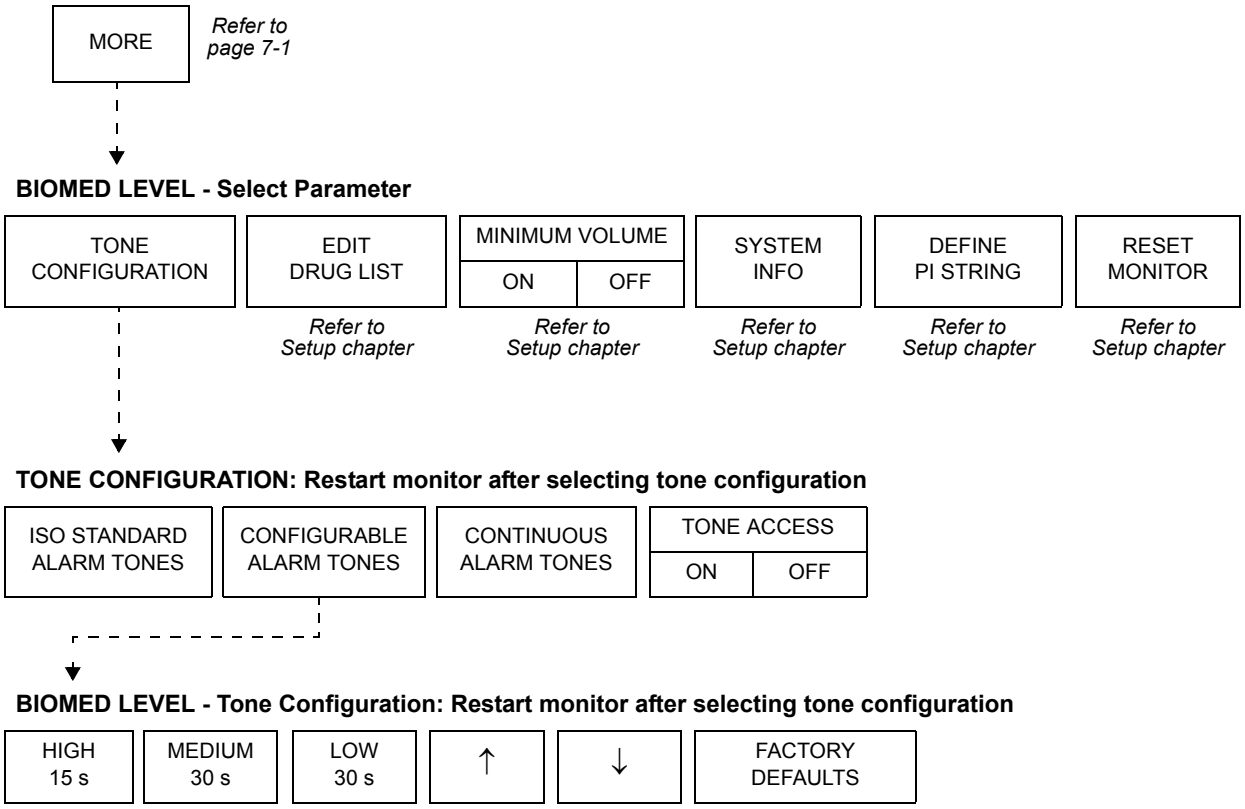
**Serial Port Configuration**

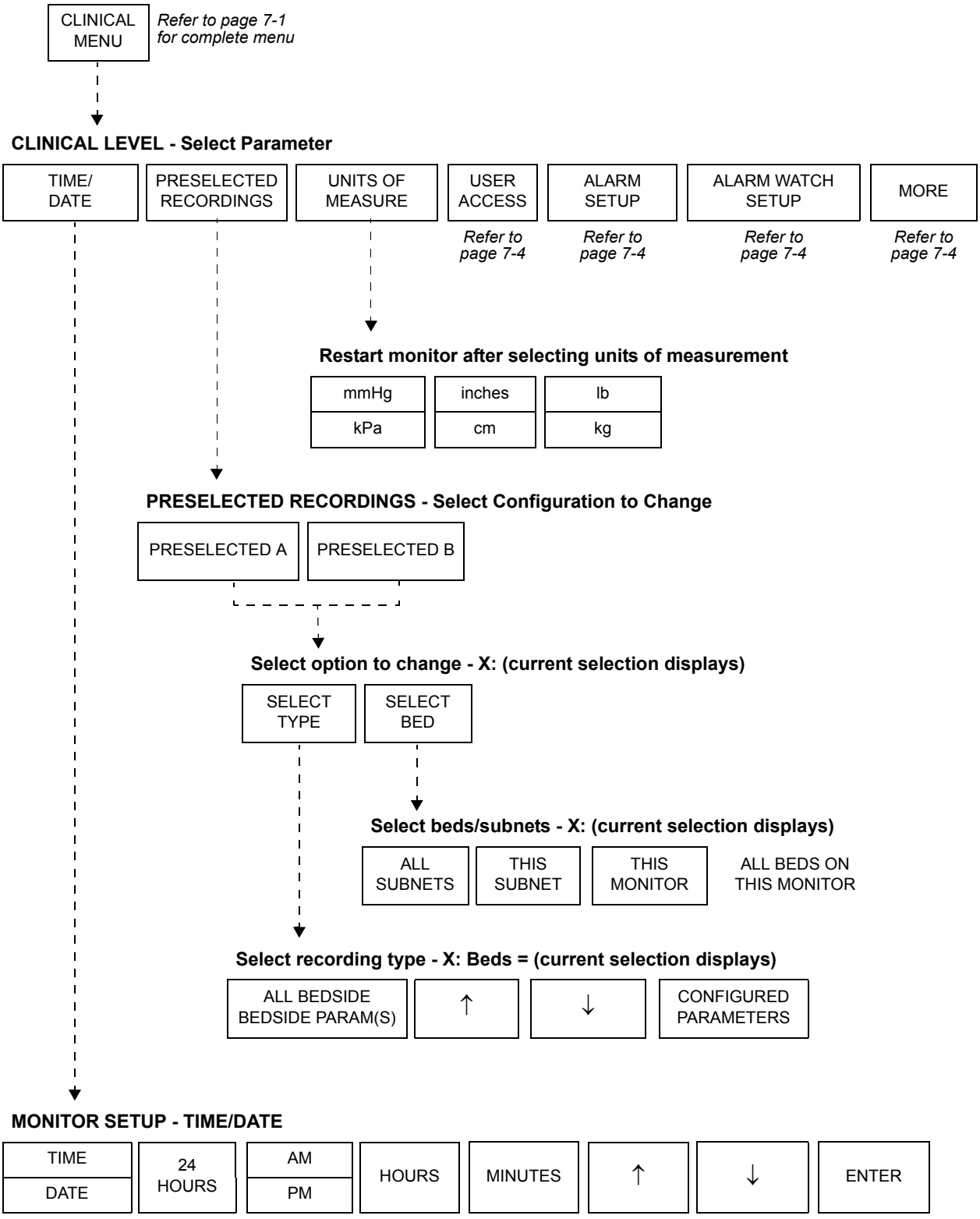
SETTINGS | ASSIGNMENT — *Defined by the options installed*

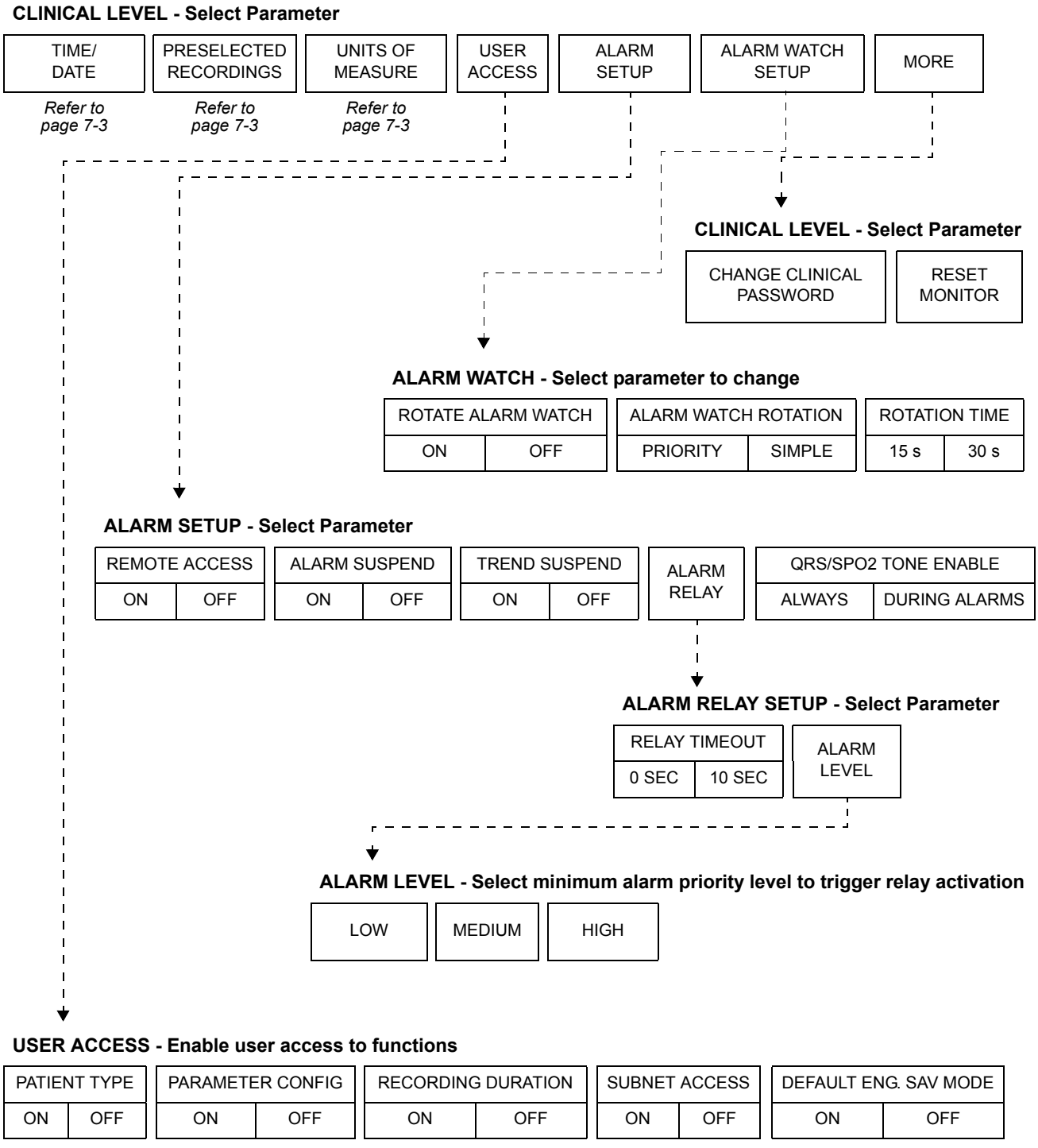
**Restart monitor after selecting owner for serial port**

DIAGNOSTICS | DATA LOGGER

| DATA BITS 8 | PARITY NONE | STOP BITS 1 | ECHO NONE | CR / LF NONE | XON / XOFF NONE | BAUD RATE |
|---|---|---|---|---|---|---|


MORE
Refer to page 7-1
BIOMED LEVEL - Select Parameter
TONE CONFIGURATION
EDIT DRUG LIST
MINIMUM VOLUME
ON
OFF
SYSTEM INFO
DEFINE PI STRING
RESET MONITOR
Refer to Setup chapter
Refer to Setup chapter
Refer to Setup chapter
Refer to Setup chapter
Refer to Setup chapter
TONE CONFIGURATION: Restart monitor after selecting tone configuration
ISO STANDARD ALARM TONES
CONFIGURABLE ALARM TONES
CONTINUOUS ALARM TONES
TONE ACCESS
ON
OFF
BIOMED LEVEL - Tone Configuration: Restart monitor after selecting tone configuration
HIGH 15 s
MEDIUM 30 s
LOW 30 s
↑
↓
FACTORY DEFAULTS


CLINICAL MENU
Refer to page 7-1 for complete menu
CLINICAL LEVEL - Select Parameter
TIME/ DATE
PRESELECTED RECORDINGS
UNITS OF MEASURE
USER ACCESS
ALARM SETUP
ALARM WATCH SETUP
MORE
Refer to page 7-4
Refer to page 7-4
Refer to page 7-4
Refer to page 7-4
Restart monitor after selecting units of measurement
mmHg
kPa
inches
cm
lb
kg
PRESELECTED RECORDINGS - Select Configuration to Change
PRESELECTED A
PRESELECTED B
Select option to change - X: (current selection displays)
SELECT TYPE
SELECT BED
Select beds/subnets - X: (current selection displays)
ALL SUBNETS
THIS SUBNET
THIS MONITOR
ALL BEDS ON THIS MONITOR
Select recording type - X: Beds = (current selection displays)
ALL BEDSIDE BEDSIDE PARAM(S)
↑
↓
CONFIGURED PARAMETERS
MONITOR SETUP - TIME/DATE
TIME
DATE
24 HOURS
AM
PM
HOURS
MINUTES
↑
↓
ENTER


CLINICAL LEVEL - Select Parameter
TIME/ DATE
PRESELECTED RECORDINGS
UNITS OF MEASURE
USER ACCESS
ALARM SETUP
ALARM WATCH SETUP
MORE
Refer to page 7-3
Refer to page 7-3
Refer to page 7-3
CLINICAL LEVEL - Select Parameter
CHANGE CLINICAL PASSWORD
RESET MONITOR
ALARM WATCH - Select parameter to change
ROTATE ALARM WATCH
ON
OFF
ALARM WATCH ROTATION
PRIORITY
SIMPLE
ROTATION TIME
15 s
30 s
ALARM SETUP - Select Parameter
REMOTE ACCESS
ON
OFF
ALARM SUSPEND
ON
OFF
TREND SUSPEND
ON
OFF
ALARM RELAY
QRS/SPO2 TONE ENABLE
ALWAYS
DURING ALARMS
ALARM RELAY SETUP - Select Parameter
RELAY TIMEOUT
0 SEC
10 SEC
ALARM LEVEL
ALARM LEVEL - Select minimum alarm priority level to trigger relay activation
LOW
MEDIUM
HIGH
USER ACCESS - Enable user access to functions
PATIENT TYPE
ON
OFF
PARAMETER CONFIG
ON
OFF
RECORDING DURATION
ON
OFF
SUBNET ACCESS
ON
OFF
DEFAULT ENG. SAV MODE
ON
OFF

# Glossary

The following terms appear in this manual:

**ASCII**

American Standard Code for Information Interchange. A standardized way of assigning numerical codes to characters and control codes.

**ATE**

Automated test equipment used in performance testing of printed circuit assemblies.

**Baud rate**

Data transfer rate associated with serial data transfers, typically between personal computers via modems. Example: 9600 bits per second.

**Bit map**

Technique of drawing computer images by mapping the image in RAM.

**BNC**

A push and twist connector that allows a fast connect/disconnect of thin coaxial cable.

**Boot ROM**

Programmed ROM devices that contain basic data required to start a digital system at power up. This data generates instructions to the processor, allowing a limited set of start-up instructions.

**CMOS RAM**

Battery backed up device used to store configuration information such as node name, node ID, or bed names.

**Composite video**

Video display signal containing both video and sync information.

**CPU**

Central Processing Unit

**CR/LF**

Carriage Return / Line Feed

**CTS**

Clear To Send signal used in communication protocols.

**DB9**

“D” shaped, 9-pin connector of either male or female gender.

**DB15**

“D” shaped, 15-pin connector of either male or female gender.

**DB15HD**

High-density, “D” shaped, 15-pin connector with DB9 shell and footprint.

**DB26**

“D” shaped, 26-pin connector of either male or female gender.

**Degauss**

Process of removing a magnetic charge from a material. Color CRT screens are most susceptible to this type of charge creating “purity” problems.

**Dot pitch**

Method of comparison used to determine the quality of a display. It indicates the angle and proximity each dot has to the other.

**DRAM**

Dynamic Random Access Memory used for computer memory systems.

**DTR**

Data Terminal Ready signal used in communications protocol.

**EEPROM**

Electrically Erasable Programmable Read Only Memory. The portion of the monitor’s memory which holds sysgen information and hardware configurations.

**EMI**

Electromagnetic Interference generated by repetitive signals such as microprocessor clocks that can interfere with other devices or two-way radio communications.

**EPP**

Enhanced Parallel Port

**ESD**

Electrostatic Discharge. High voltage potentials carried on the body that are generated by walking across a carpeted floor or caused by low humidity environments, which can be discharged into an electronic device, damaging it.

**Ethernet**

The LAN technology that uses CSMA/CD physical access method and 10/100 Mbps digital transmission. The forerunner of the IEEE802.3 CSMA/CD standard.

**Ferrite**

RF (radio frequency) glossy material used in EMI suppression.

**FPGA**

Field-Programmable Gate Array.

**Flexport System Interface**

Spacelabs Medical device that communicates via RS232 with other manufacturer's equipment.

**GDS**

Global Data System

**High level output**

Analog signals supplied through a separate connector for use with external equipment.

**I/O**

Input/Output port or device

**IEEE**

A U.S. professional organization active in the creation, promotion, and support of communications specifications and standards.

**IP Address**

Internet Protocol Addresses used in TCP/IP. Identifies packet origin/destination.

**IRTS**

Infrared Touchscreen. One of the user interfaces to the Spacelabs Medical monitoring system.

**LAN**

Local Area Network. A network system that provides a relatively small area with high speed data transmission at a low error rate.

**Light transmittance**

Measure of light levels as measured at the face of the CRT.

**Lithium**

Material used to construct a high energy battery for use in CMOS backed circuits.

**Mbit**

Measurement used for RAM devices. Example: a 4 Mbit device will contain 4 megabits of data.

**Monitor Name**

Unique name entered into the monitor, identifying it to all other monitors on the network.

**Monitor ID**

Unique identification entered into the monitor, allowing an Ethernet address to be assigned.

**NTSC**

National Television Standard used for U.S. television video formats.

**NVRAM**

Non-Volatile RAM

**OTPROM**

One Time Programmable Read Only Memory device

**PAL**

International television video format

**PCB or PCBA**

Printed Circuit Board or PCB Assembly

**PCI**

Peripheral Component Interconnect

**PCIS™**

Patient Care Information System

**PCMCIA**

Personal Computer Memory Card International Association. Refers to the type of type I card that adds ROM or RAM and can be exchanged without rebooting the system.

**PCMS™**

Patient Care Management System

**PFAIL**

Power Failure notification line used to notify the CPU of an imminent AC power failure.

**PIXEL**

Smallest unit displayed on a CRT. One PIXEL equals a single dot on the display.

**Plenum rated**

Cable that must be used where toxic gases created by heat during a fire could not be tolerated. The plenum term refers to the return air path for an air conditioning system.

**PM**

Preventive Maintenance

**PMC**

PCI Mezzanine Card

**Primary printer**

Network printer that has first priority in receiving print requests.

**Printer Name**

Name placed into the monitor to allow the user to send hard copy recordings to a specific network printer.

**Privileged access**

Monitor operations not accessible to all users. A password is required to access these functions.

**PS/2**

IBM standard

**PVC**

Poly Vinyl Chloride used in production of non-plenum cables.

**RAMDAC**

Digital-to-Analog Converter with memory that converts digital video to analog video.

**RGB**

Red, Green, Blue

**RISC**

Reduced Instruction Set Computing

**ROM**

Read Only Memory

**RTC**

Real Time Clock

**RTGL**

Real Time Graphics Library

**RTS**

Ready-To-send signal used in communications protocols.

**RXD**

Receive Data. Used in communications protocols.

**SDLC**

Synchronous Data Link Control. Used for communication between the monitor and external devices such as modules, telemetry housings or Flexport interfaces.

**Secondary printer**

Network printer where printing requests made at a bedside or central are sent to if a primary printer is busy.

**SIMM**

Single In-line Memory Module

**SMA**

Shared Memory ASIC

**SRAM**

Static RAM (CMOS RAM)

**Stop bits**

Quantity of bits used to discontinue transfer block in serial communications.

**Subnet Name**

Unique subnetwork name identifying logically separated networks.

**Sysgen**

Spacelabs Medical's method to enable purchased options.

**Tap block plug**

Dummy plug used to seal up an unused hole tapped into a coaxial cable on an Ethernet system.

**Tap block**

Device used to "tap" into an active or inactive Ethernet coax cable.

**TCP/IP**

Transmission Control Protocol/Internet Protocol used as an underlying mechanism for moving packets of information between different machines on a local or wide-area network.

**TLB**

Translation Lookaside Buffer

**Terminator**

A resistive load attached to each end of a coaxial cable segment, or at a single end of an SDLC line. The function of a terminator is to match the characteristic impedance of the cable.

**Transceiver (Ethernet)**

Device located on coax cable or line powered attaching monitors to the network. These devices are bi-directional.

**TXD (Transmit Data)**

Transmit Data. Used in communications protocols.

**UPS**

Uninterruptible Power Supply. Used to hold power up until AC mains are restored.

**USB**

Universal Serial Bus

**VBA**

Video Bus Array

**VBB**

Lithium Voltage Battery Backup

**VPP**

Voltage used for programming devices

**VRAM**

Video RAM

**WDT**

Watch Dog Timer

**XON/XOFF**

Used in communication definitions

# Appendix A - Electromagnetic Compatibility

## Contents


Electromagnetic Emissions . . . . . 1
Electromagnetic Immunity . . . . . 1
Separation Distances . . . . . 3


## Electromagnetic Emissions

| Emission Test | Compliance | Electromagnetic Environment |
|---|---|---|
| RF emissions **CISPR 11** | Group 1 Class B | The monitor uses RF energy only for internal function. Therefore, RF emissions are very low and are not likely to cause any interference in nearby electronic equipment |
| Harmonic emissions **IEC 61000-3-2** | Complies | Device Class A |
| Voltage fluctuations/flicker **IEC 61000-3-3** | Complies | |

## Electromagnetic Immunity

***Note:***

*The monitor is intended for use in the electromagnetic environment specified below. The customer, or user, of the monitor should ensure that it is used in such an environment*

| Immunity Test | IEC 60601 Test Level | Compliance Level | Electromagnetic Environment |
|---|---|---|---|
| Electrostatic discharge (ESD) **IEC 61000-4-2** | ±6 kV contact<br>±8 kV air | 8 kV contact<br>15 kV air | Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%. |
| Electrical fast transient/burst **IEC 61000-4-4** | ±2 kV for power supply lines<br>±1 kV for input/output data lines | ±2 kV for power supply lines<br>±1 kV for input/output data lines | Mains power quality should be that of a typical commercial or hospital environment. |
| Surge **IEC 61000-4-5** | ±1 kV differential mode<br>±2 kV common mode | 1 kV differential mode<br>2 kV common mode | Mains power quality should be that of a typical commercial or hospital environment. |

| Immunity Test | IEC 60601 Test Level | Compliance Level | Electromagnetic Environment |
|---|---|---|---|
| Voltage dips, short interruptions, and voltage variations on power supply input lines **IEC 61000-4-11** | **<5% $U_T$** (>95% dip in $U_T$ for 0.5 cycle) **40% $U_T$** (60% dip in $U_T$ for 5 cycles) **70% $U_T$** (30% dip in $U_T$ for 25 cycles) **<5% $U_T$** (>95% dip in $U_T$ for 5 seconds) | **<5% $U_T$** (>95% dip in $U_T$ for 0.5 cycle) **40% $U_T$** (60% dip in $U_T$ for 5 cycles) **70% $U_T$** (30% dip in $U_T$ for 25 cycles) **<5% $U_T$** (>95% dip in $U_T$ for 5 seconds) | Mains power quality should be that of a typical commercial or hospital environment.<br><br>The monitor automatically switches to internal battery operation during mains power interruptions. |
| Power frequency (50/60 Hz) magnetic field **IEC 61000-4-8** | 3 A/m | 60 A/m | Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment. |
| **Note:** $U_T$ is the AC mains voltage prior to application of the test level. All power line immunity tests were performed at 120 VAC/60 Hz and 230 VAC/50 Hz. | | | |

# Separation Distances

***Note:***

*The monitor is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer, or user, of the monitor can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the monitor, as recommended below, according to the maximum output power of the communications equipment.*

**Recommended Separation Distances Between Portable and Mobile RF Communications Equipment and the Monitor (Always evaluate electronic equipment on site before use.)**

| Immunity Test | IEC 60601 Test Level | Compliance Level | Electromagnetic Environment |
|---|---|---|---|
| Conducted RF **IEC 61000-4-6**<br><br>Radiated RF **IEC 61000-4-3** | 3 Vrms<br>150 kHz to 80 MHz<br><br>3 Vm<br>80 MHz to 2.5 GHz | 20 V r.m.s<br>1 kHz sine<br>80% AM<br><br>20 V/m<br>1 kHz sine<br>80% AM | Portable and mobile RF communications equipment should be used no closer to any part of the monitor, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.<br>**Recommended separation distance:**<br>$d = \left[\frac{3.5}{V_1}\right]\sqrt{P}$<br>150 kHz to 80 MHz<br>$d = \left[\frac{3.5}{E_1}\right]\sqrt{P}$<br>80 MHz to 800 MHz<br>$d = \left[\frac{7}{E_1}\right]\sqrt{P}$<br>800 MHz to 2.5 GHz<br>Where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer, and *d* is the recommended separation distance in meters (m).<br>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,* should be less than the compliance level in each frequency range.**<br> Interference may occur in the vicinity of equipment marked with the following symbol. IEC 60417-5140: Non-ionizing electromagnetic radiation |

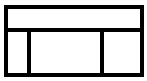
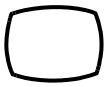
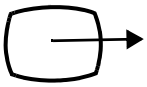
* *Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the monitors are used exceeds the applicable RF compliance level above, the monitors should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the monitors.*

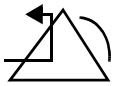
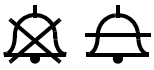
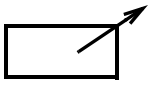
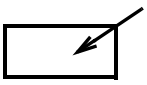
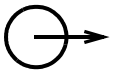
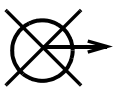
** *Over the frequency range 150 kHz to 80 MHz, field strengths should be less than [ $V_1$ ] V/m.*

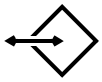
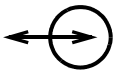
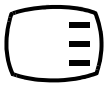
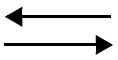
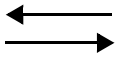
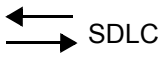
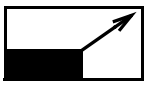
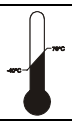
| Rated maximum output power of transmitter (watts) | Separation distance according to frequency of transmitter (meters) | | |
|---|---|---|---|
| | 150 kHz to 80 MHz | 80 MHz to 800 MHz | 800 MHz to 2.5 GHz |
| 0.01 | 0.02 | 0.02 | 0.04 |
| 0.1 | 0.06 | 0.06 | 0.1 |
| 1 | 0.2 | 0.2 | 0.4 |
| 10 | 0.6 | 0.6 | 1.1 |
| 100 | 1.8 | 1.8 | 3.5 |
| **Note 1:** At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.<br>**Note 2:** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people. | | | |

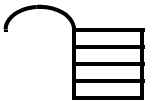
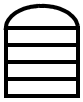
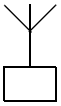
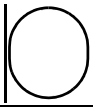
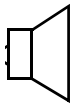
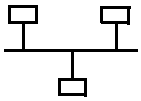
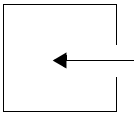
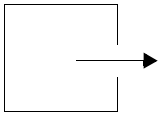
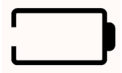
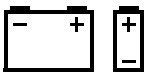
# Symbols

The following list of international and safety symbols describes all symbols used on Spacelabs Medical products. No one product contains every symbol.

| Symbol | Description | Symbol | Description |
|---|---|---|---|
| | HELP Key |  | Keyboard Connection |
| | SPECIAL FUNCTIONS Key | | Mouse connection |
| | RECORD Key | | START/STOP Key |
| | NORMAL SCREEN Key | | START/STOP |
| | MONITOR SETUP Key | | STOP or CANCEL Key |
| | ALARMS Key | | CONTINUE Key |
| | PREVIOUS MENU Key | | ENTER Key |
|  | ON — Power Connection to Mains | | OFF — Power Disconnection from Mains |
| | ON Position for Push Button Power Switch | | OFF Position for Push Button Power Switch |
|  | On Direction | | ON/OFF |
|  | Television; Video Display |  | Video Output |
| | ON — Part of the Instrument Only | | OFF — Part of the Instrument Only |

| Symbol | Description | Symbol | Description |
|---|---|---|---|
| | Stand-by | | STAND-BY Key |
| | PAUSE or INTERRUPT | | Slow Run |
|  | Reset | | Power Indicator LED |
| | Alarm |  | Temporary Shut Off of Alarm Tone or Screen Indicators |
|  | Indicator — Remote Control |  | Indicator — Local Control |
| | PRINT REPORT Key | | Indicator — Out of Paper |
| | Partial ON/OFF | | Recorder Paper |
| | Normal Screen | | Return to Prior Menu |
| | Clock/Time Setting Key | | TREND/TIMER Key |
| ? | HELP (Explain Prior Screen) Key | | Keypad |
| | Activate Recorder for Graphics | | Indoor Use Only |
| | START (NIBP) Key | | Auto Mode (NIBP) |
|  | Output |  | No Output (Terminated) |

| Symbol | Description | Symbol | Description |
|---|---|---|---|
|  | Data Input/Output |  | Input/Output |
| | Input | | Reset |
| | Menu Keys |  | Waveform/Parameter Keys |
| | Monitor Setup<br>Select Program Options | | Set Initial Conditions Menu |
| | Access Special Function Menu | | Return Unit to Monitor Mode |
|  | Serial Port 1 |  | Serial Port 2 |
| | External marker push button connection |  | SDLC Port |
| | Arterial Pulse | | Electrocardiograph or Defibrillator Synchronization |
| | Gas Exhaust | | Foot Switch |
|  | Enlarge, Zoom | | Delete |
| | PCMCIA Card | | Event |
| | Keep Dry | | Fragile; handle with care |
| | Environmental Shipping/Storage Altitude Limitations | | This Way Up |
|  | Environmental Shipping/Storage Temperature Limitations | | Environmental Shipping/Storage Humidity Limitations |

| Symbol | Description | Symbol | Description |
|---|---|---|---|
|  | Open Padlock |  | Closed Padlock |
| | Down Arrow | | Up Arrow |
| | Hard Drive | | Power Indicator LED |
| | Antenna |  | Mermaid Connector |
|  | Microphone | | Omnidirectional Microphone |
|  | Audio Output, Speaker | | Activate Telemetry Recorder |
|  | Network Connection | | Universal Serial Bus |
|  | Gas Sampling Port |  | Gas Return Port |
| | Remote Alarm; Nurse Alert | | Nurse Call |
|  | Battery Status | | Low Battery |
| | Battery<br>Replace only with the appropriate battery. |  | Replace only with the appropriate battery.<br>(+ / - signs may be reversed) |
| | All batteries should be disposed of properly to protect the environment. Lithium batteries should be fully discharged before disposal. Batteries such as lead-acid (Pb) and nickel-cadmium (Ni-Cd) must be recycled. Please follow your internal procedures and or local (provincial) laws regarding disposal or recycling. | | Caution - hazardous voltages. To reduce risk of electric shock, do not remove the cover or back. Refer servicing to a qualified service personnel (U.S.A.).<br><br>DANGER - High Voltage (International) |

| Symbol | Description | Symbol | Description |
|---|---|---|---|
| | Protective Earth Ground | | Functional Earth Ground |
| | Replace Fuse Only as Marked | | Fuse |
| | Power supply jack polarity.<br>(+ / - signs may be reversed) | | Equipotentiality Terminal |
|  | Alternating Current | | Direct Current |
| | Both Direct and Alternating Current | | AC/DC Input |
| A | Amperes | Hz | Hertz |
| V | Volts | W | Watts |
| | IEC 601-1 Type B equipment. The unit displaying this symbol contains an adequate degree of protection against electric shock. | | Class II Equipment |
| | IEC 601-1 Type BF equipment which is defibrillator-proof. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part which contains an adequate degree of protection against electric shock, and is defibrillator-proof. | | IEC 601-1 Type BF equipment. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part providing an adequate degree of protection against electric shock. |
| | IEC 601-1 Type CF equipment. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part providing a high degree of protection against electric shock, and is defibrillator-proof. | | IEC 601-1 Type CF equipment. The unit displaying this symbol contains an F-type isolated (floating) patient-applied part providing a high degree of protection against electric shock. |
| | Loop Filter | | Adult NIBP |

| Symbol | Description | Symbol | Description |
|---|---|---|---|
| | ETL Laboratory Approved | | Canadian Standards Association Approved |
| | Risk of Explosion if Used in the Presence of Flammable Anesthetics | | Operates on Non-Harmonized Radio Frequencies in Europe |
| ***Note*** | Note | | Attention - Consult Operations or Service Manual for Description |
| ***WARNING*** | Warning About Potential Danger to Human Beings | **CAUTION** | Caution About Potential Danger to a Device |
| | Non-Invasive Blood Pressure (NIBP), Neonate | | Fetal Monitor Connection (Analog) |
| | Fetal Monitor Connection RS232 (Digital) | | Physiological Monitor Connection RS232 (Digital) |
| | Happy Face | | Sad Face |
| | Magnifying Glass | | Compression |
| | File Cabinet | | List of Rooms |
| | Arrows | | Printer |
| | Recycle | | Service Message |
| | Radio transmitting device; elevated levels of non-ionizing radiation | | |

Abbreviations used as symbols are shown below.

| Symbol | Description | Symbol | Description |
|---|---|---|---|
| **1 - 32** | Access Codes<br>1 Through 32 | **AIR** | Air |
| **ANT 1**<br>**ANT 2** | Diversity Antenna System 1<br>Diversity Antenna System 2 | **Arr1**<br>**ArrNet2** | Arrhythmia Net 1<br>Arrhythmia Net 2 |
| **CH**<br>**ch** | EEG, EMG, or ECG Channel<br>EEG Channels - CH1, CH2, CH3, CH4<br>EMG Channel - CH5 | **cm$H_2O$** | Centimeters of Water |
| **C.O.**<br>**CO**<br>**co** | Cardiac Output | **DIA**<br>**dia** | Diastolic |
| **ECG**<br>**ecg** | Electrocardiogram | **EEG**<br>**eeg** | Electroencephalogram |
| **EMG**<br>**emg** | Electromyogram | **ESIS** | Electrosurgical Interference Suppression |
| **EXT** | External | **FECG** | Fetal Electrocardiogram |
| **FHR1**<br>**FHR2** | Fetal Heart Rate, Channel 1<br>Fetal Heart Rate, Channel 2 | **GND**<br>**gnd** | Ground |
| **HLO**<br>**hlo** | High-Level Output | **Multiview** | Multi-Lead Electrocardiogram |
| **NIBP**<br>**nibp** | Non-Invasive Blood Pressure | **$N_2O$** | Nitrous Oxide |
| **$O_2$** | Oxygen | **PRESS**<br>**press**<br>**PRS** | Pressure |
| **RESP**<br>**resp** | Respiration | **SDLC** | Synchronous Data Link Control |
| **SPO2**<br>**SpO2**<br>**$SpO_2$**<br>**$SaO_2$** | Arterial Oxygen Saturation<br>as Measured by Pulse Oximetry | **SVO2**<br>**$S\underline{v}O2$**<br>**$SvO_2$** | Mixed Venous Oxygen Saturation |

| Symbol | Description | Symbol | Description |
|---|---|---|---|
| **SYS**<br>**sys** | Systolic | **T1**<br>**T2**<br>**T3**<br>**T4** | Temperature 1<br>Temperature 2<br>Temperature 3<br>Temperature 4 |
| **TEMP**<br>**temp** | Temperature | **UA** | Uterine Activity or Umbilical Artery |
| **VAC** | Vacuum Connection | | |